

*The* NATIONAL  
**NC 303**  
COMMUNICATIONS RECEIVER



1766

# STANDARD FORM WARRANTY

ADOPTED BY THE RADIO MANUFACTURERS ASSOCIATION, INC.

This equipment is warranted to be free from defective material and workmanship and repair or replacement will be made of any part which under normal installation, use and service discloses defect, provided the unit is delivered by the owner to the manufacturer or through the authorized radio dealer or wholesaler from whom purchased, intact, for examination, with all transportation charges prepaid to the factory, within ninety days from the date of sale to original purchaser, and provided that such examination, discloses in the manufacturer's judgment that it is thus defective.

This warranty does not extend to any radio products which have been subjected to misuse, neglect, accident, incorrect wiring, improper installation, or to use in violation of instructions furnished by the manufacturer, nor extend to units which have been repaired or altered outside of the factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith of other manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for the manufacturer any other liability in connection with the sale of their radio products.

National Company, Inc. reserves the right to make any change in design or to make addition to, or improvements in, its products without imposing any obligations upon itself to install them in its products previously manufactured.

# INSTRUCTION MANUAL

## for the



## NATIONAL NC303 COMMUNICATIONS RECEIVER

### SECTION 1 DESCRIPTION

#### 1.1 GENERAL

Your National Model NC-303 is an amateur-band receiver incorporating all the design features necessary to provide optimum performance consistent with present day operating requirements. Elimination of general frequency coverage and all circuits not pertinent to amateur operation has enabled National to produce a compact, efficient receiver with the built-in rugged dependability characteristic of National Company products. Contributing to the utility of the receiver are a Q multiplier rejection notch, an S-meter, variable IF selectivity plus selectable SSB with a fast-attack — slow-release AGC circuit, a muting circuit, a heterodyne detector, and separate noise limiters for AM and for SSB and CW reception. These operational features as well as basic design improvements result in a receiver with exceptional oscillator stability, high sensitivity, and extreme versatility.

Your NC-303 features a double-conversion superheterodyne circuit employing 15 tubes including the rectifier, voltage regulator and current stabilizer. Through careful selection of intermediate frequencies, excellent

selectivity and image rejection have been achieved. Frequency coverage includes the 160, 80, 40, 20, 15, 11 and 10 meter bands plus the "X" band. The "X" band functions as a tunable IF in the 30- to 35-megacycle range for use with broad-band crystal converters available from the National Company. Individual scales provide direct reading calibration for 6, 2 and 1 1/4 meters. Each amateur band has an individual calibrated dial scale. Tuning is facilitated by the fact that only the calibrated dial scale that is in use is visible. Band-scanning is accomplished with ease as a result of the use of a heavily-weighted tuning knob coupled to a free-moving gear train. The tuning knob has a rim-drive vernier to aid in fine tuning. Careful attention to mechanical design has resulted in tuning action without any trace of backlash.

The outward appearance of the receiver is completely modern and functional. Cabinet and panel construction permits the receiver to be removed from the cabinet and rack mounted without the addition of any parts other than mounting hardware. Adequate ventilation is provided by the use of convection cooling through holes in the chassis and perforated cabinet lid.

## 1.2 FREQUENCY COVERAGE

Your NC-303 tunes all the amateur bands from 160 through 10 meters plus a 30- to 35-mc band designated as the "X" band for use with external converters for the 6-, 2- and  $1\frac{1}{4}$ -meter bands. Each dial scale is calibrated for only one band. Each scale has band-limit markings plus underscoring to indicate the phone portion of the band. The dial drum rotates with the band switch so that only the dial scale associated with the band being tuned is visible. The following table gives the frequency of each band tuned by your NC-303.

BAND	FREQUENCY RANGE
160	1.8 - 2.0 mc
80	3.5 - 4.0 mc
40	7.0 - 7.3 mc
20	14.0 - 14.4 mc
15	21.0 - 21.5 mc
11	26.5 - 27.5 mc
10	28.0 - 29.7 mc
6	49.5 - 54.5 mc (with converter)
2	143.5 - 148.5 mc (with converter)
$1\frac{1}{4}$	220.0 - 225.0 mc (with converter)
WWV	10.0 mc (with calibrator)

## 1.3 CONTROLS

The following controls appear on the front panel of your NC-303:

Tuning Knob and Vernier

AFG — Audio frequency gain control

RFG — RF gain control

TONE (HI-N-LO-PK) — Audio response switch

ANL — Automatic AM and manual CW-SSB Noise Limiters

MODE (ACC-AM-CW-SSB) — Operating mode

SELECT (S-SB1-SB2-M-B) — IF selectivity

BAND — Tuning range selector

CWO — Heterodyne detector oscillator tuning

NOTCH — Q multiplier notch tuning

DEPTH — Q multiplier notch depth control

ANT — Antenna trimmer

CAL-SET — Pointer position control

OFF-CAL-WWV — Crystal calibrator function switch

XMT-REC — Standby-Operate switch

## 1.4 IF SELECTIVITY

The IF passband may be set at S(400 cps), SB1(2 kc), SB2(2 kc), M(3.5 kc), or B(8 kc), at the operator's discretion. The S, M and B positions are centered on 80 kc, with the SB1 and SB2 positions centered at 81.5 and 78.5 kc respectively. Figure 1 shows the IF selectivity characteristics. With the ever increasing amount of activity on the amateur bands, variable selectivity is a must on any modern communications receiver. For copying CW signals in the midst of heavy QRM, the 400-cycle bandwidth is invaluable. The SB1 and SB2 positions are special features of your NC-303 which allow instantaneous one-knob selection of the correct sideband for SSB reception. These positions provide optimum bandwidths of 2 kc centered on the received sideband. Either sideband of a DSB signal may be selected for optimum reception. The M position is provided to improve the readability of phone operation when interference is heavy, and the B position makes it possible to copy net stations or round table discussions with a minimum of retuning. Attention to the 8-kc bandwidth is also important when the converters in the VHF ranges are being used.

## 1.5 Q MULTIPLIER

An adjustable rejection notch is invaluable in reducing interference caused by heterodynes in the reception of phone signals. The Q multiplier in your NC-303 provides a very sharp rejection notch that may be positioned anywhere in the IF passband to reject interfering carriers. Use of the rejection notch does not affect the intelligibility of the desired signal. Figure 1 illustrates the Q multiplier rejection notch.

## 1.6 NOISE LIMITERS

Noise suppression in your NC-303 is accomplished by two separate noise limiters, one for AM reception and the other for CW and SSB reception. The clipping level of the AM noise limiter is set at an optimum value of 40% to 50% modulation and automatically maintains the best signal-to-noise ratio regardless of signal strength. One of the outstanding features of your NC-303 is a double-ended noise limiter separate from the AM noise limiter with a manually adjustable clipping level for CW and SSB. This limiter clips both positive and negative noise peaks.

## 1.7 MUTING CIRCUIT

A built-in muting circuit silences your NC-303, when desired, without resorting to the use of relays. Any point in the transmitter, which supplies approximately minus 22 volts with the transmitter on, may be connected

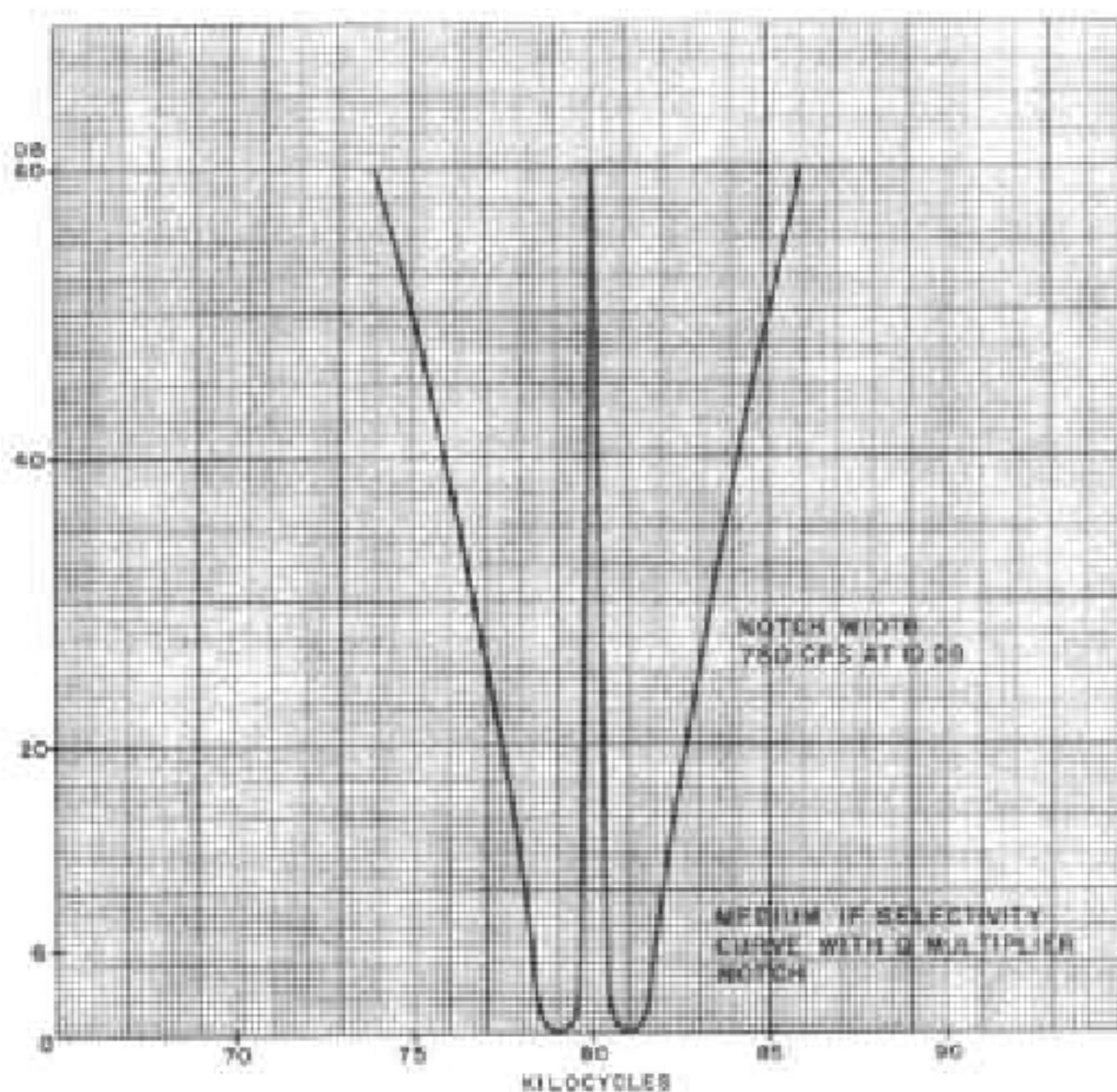
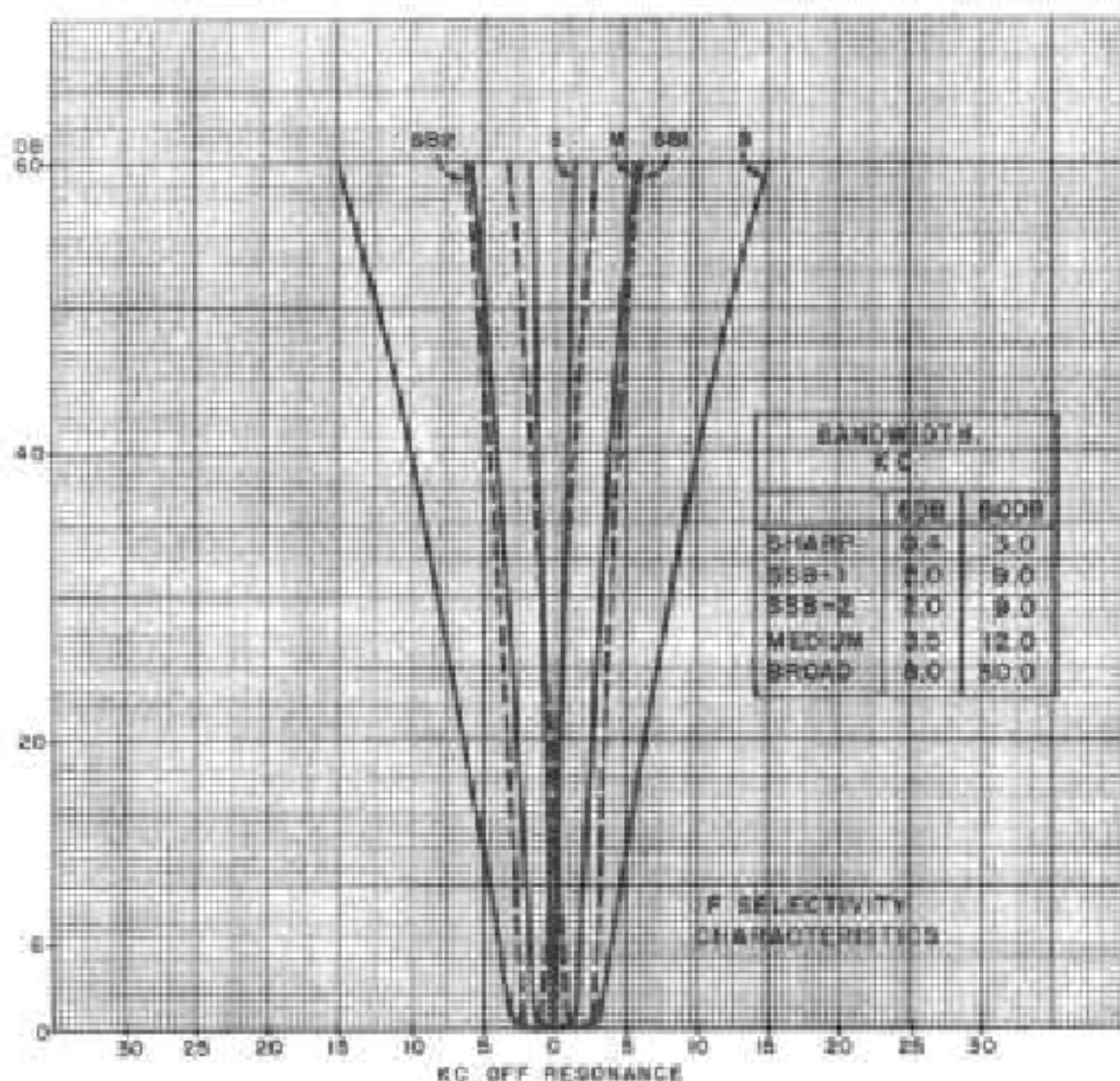


Figure 1. IF and Q Multiplier Selectivity Characteristics

to the muting terminals at the rear of the receiver. When the transmitter is energized, the audio amplifier in the receiver is cut off to prevent feedback or key clicks.

#### 1.8 SINGLE-SIDEBAND DETECTION

Incorporated in your NC-303 are unique features which provide stable, distortion-free SSB reception without noise bursts and/or ignition interference. The IF selectivities of SELECT control positions SB1 and SB2 provide optimum bandwidths for SSB reception. (See IF Selectivity Characteristic curves, Figure 1.) The operator may select either sideband with one control and may switch sideband without retuning the receiver or CWO control. Frequency stability is assured in your NC-303 by using a first conversion oscillator with regulated plate voltage, heater current stabilization and a carefully temperature compensated high-C circuit. The use of a crystal controlled second conversion oscillator eliminates any possibility of frequency drift from this source. The heterodyne detector oscillator (CWO) utilizes another high-C tuned circuit to provide stable, distortion-free audio from the incoming SSB signal. A special fast-attack — slow-release AGC circuit provides essentially constant-level output at all times. A separate noise limiter has been included to improve SSB and CW reception.

Your NC-303 has provision for a slow tuning rate by means of a push-to-engage, pull-to-release vernier rim drive for the main tuning knob. This vernier reduces the tuning rate to one-seventh of that provided by the main knob. The SSB signal may be rapidly tuned in by the main knob, then the vernier may be engaged to easily tune for maximum intelligibility. The vernier may be disengaged at any time without changing the receiver tuning by pulling the vernier knob outward.

#### 1.9 AUDIO RESPONSE

A tone switch has been provided to allow selection of the best audio response for the existing signal conditions. Provision is made to attenuate the low and high frequency portions of the audio spectrum, either individually or together.

#### 1.10 VOLTAGE AND CURRENT REGULATION

The filament current of the first conversion oscillator in your NC-303 is regulated through current stabilizer tube V-13(4H4-C). The result of this regulation is less than a 50-cycle shift in oscillator frequency on the 10-meter band for a 10% change in line voltage. Plates and screens of the 1st and 2nd conversion oscillators are voltage regulated by the voltage regulator tube V-11(OB2).

## 1.11 CONVERTERS AND CABINET

The National NC-300C1, NC-300C2 and NC-300C6A broad-band, crystal-controlled converters tune the 1 1/4-, 2-, and 6-meter bands respectively. The slide rule dial of your NC-303 incorporates three separate dial scales to provide direct-reading frequency calibration when the converters are used with the receiver. All operating voltages required by the converters are available at the accessory socket of your NC-303.

The National NC-303 converter cabinet is designed to provide a convenient and attractive means of mounting the converters. From one to three converters may be mounted in the cabinet which matches the receiver cabinet and is identical in size to the NC-303 speaker cabinet. A four-position switch is mounted on the front panel to permit operation of the receiver or any one of the three converters without changing connections to the receiver or antenna.

## 1.12 S-METER

The S-meter gives the operator a true indication of relative strength of incoming signals. The meter is calibrated in S units from 0 to 9 and in decibels from S-9 to 40 db over S-9. A potentiometer is provided on the chassis to zero-set the meter.

## 1.13 TUBE FUNCTIONS

The following table lists the types and functions of all tubes used in your NC-303:

TUBE TYPE	FUNCTION
6BZ6	RF Amplifier
6AH6	HF Oscillator
6BA7	First Mixer
6BE6	Second Converter

12AX7	Q Multiplier
6BJ6	First IF Amplifier
6BJ6	Second IF Amplifier
6ALS	AM Detector, Noise Limiter, AGC
6ALS	SSB-CW Noise Limiter
6BE6	Product Detector
12AT7	S-meter Amplifier and AF Amplifier
6AQ5	Audio Output Amplifier
5Y3GT	High Voltage Rectifier
OB2	Voltage Regulator
4H4-C	Current Stabilizer
1N1692	AGC Clamp Diode

## 1.14 POWER REQUIREMENTS

Your NC-303 requires a 105-130 volt, 50/60 cycle AC source of supply. Power consumption is approximately 70 watts.

## 1.15 CALIBRATOR SOCKET

A socket is provided on the chassis to permit insertion of the National XCU-303 or XCU-300 crystal calibrator unit. When the OFF-CAL-WWV switch on your NC-303 is in the CAL position 100 kc markers are generated for checking dial calibration. When it is in the WWV position, the calibrator can be checked against the 10 mc WWV signal. Calibration of the crystal calibrator frequency against WWV is available only with the XCU-303 calibrator.

## 1.16 ACCESSORY SOCKET

The accessory socket provided at the left rear corner of the chassis is designed to accept suitable external accessories within the power limitations of 1.5 amperes at 6.3 volts AC and 25 milliamperes at 150 volts DC. See the schematic diagram for pin connections. Refer to Section 3 for instructions on the use of external accessories.

# SECTION 2 INSTALLATION

## 2.1 GENERAL

All installation procedures are described in this section. Figure 2 locates connection points on the receiver and depicts typical installations. Before proceeding with installation, raise the hinged cover of your receiver and make sure that all tubes are seated firmly in their sockets.

## 2.2 LOUDSPEAKER

A National type NTS-2 speaker or any permanent

magnet dynamic speaker with a 3.2-ohm voice coil may be connected to the speaker terminals. No polarity need be observed.

## 2.3 CHANGEOVER RELAY

A terminal marked RELAY is mounted at the rear of your receiver. When the XMT-REC switch is set at XMT, the two RELAY terminals are shorted. Thus, they may be used to complete any external relay circuit whether it be AC or DC so long as the circuit require-

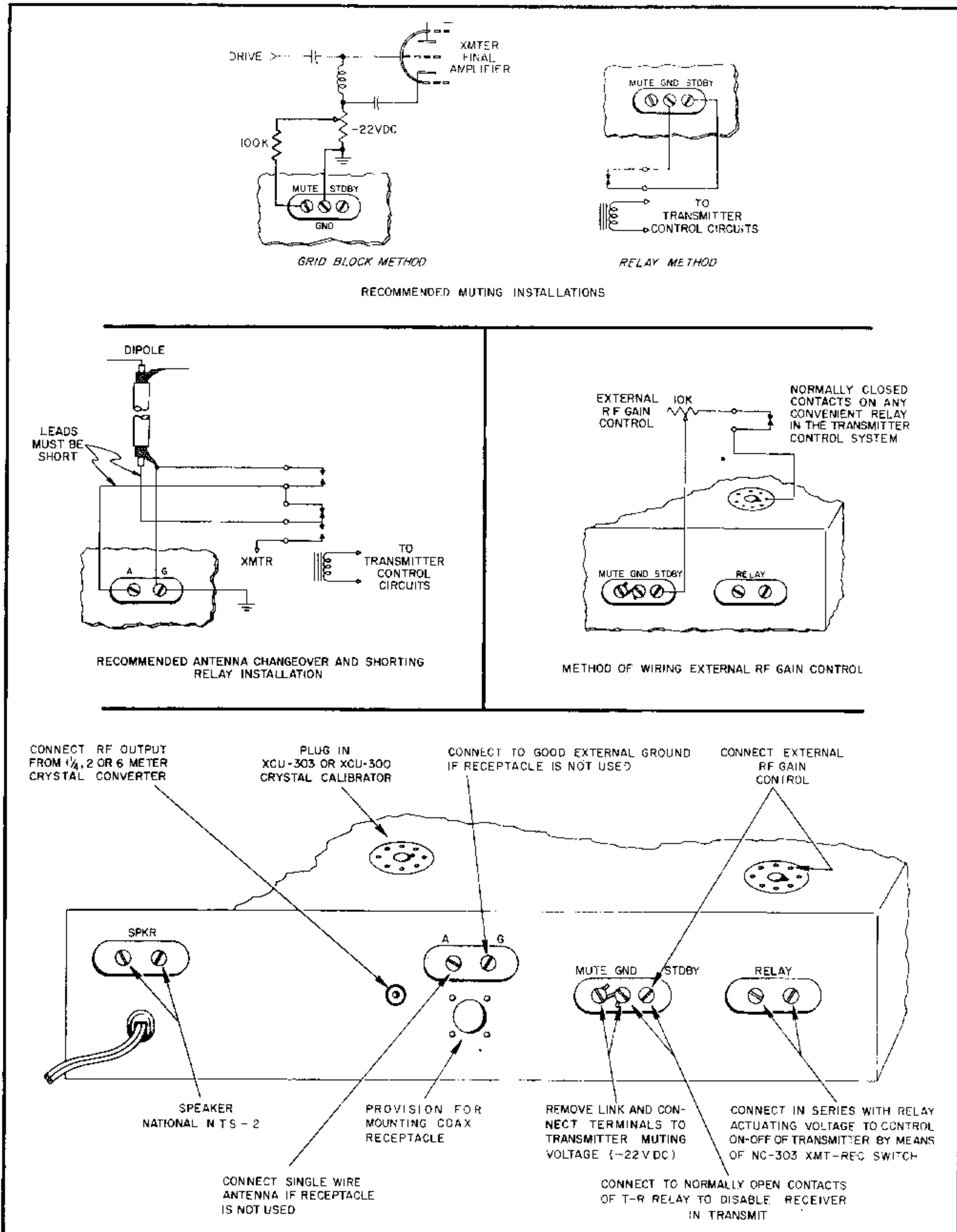


Figure 2. Typical Installation Plan

ments do not exceed 5 amps at 125 volts AC. A typical circuit might consist of a 110-volt AC antenna change-over relay in parallel with the transmitter plate supply relay, with one side of the AC line broken by the NC-303 RELAY connector strip. When connected in this manner the XMT-REC switch on the receiver front panel performs all the required change-over operations for the entire station.

## 2.4 MUTING

A MUTE-GND-STDBY terminal strip is mounted at the rear of the receiver. These three terminals provide for two entirely different methods of receiver muting during transmitting periods. With no external connections made to the strip, the receiver will be muted whenever the XMT-REC switch is placed in XMT position. If muting is not desired (for transmitter monitoring etc.) a jumper wire may be connected between STDBY and GND. The receiver now operates regardless of the XMT-REC switch position. For remote switching of the receiver, connect leads from the remote switch to the STDBY and GND terminals leaving the NC-303 switch in the XMT position. If CW break-in operation is desired, the MUTE and GND terminals may be used to mute the receiver. To accomplish this it is necessary to find a point in the transmitter circuits that will provide a source of negative 22 to 50 volts when the transmitter is on. (A 100,000 ohm resistor connected to the grid of a keyed stage which develops at least minus 22 volts with the key down will suffice.) Since grid blocking is employed in your receiver, no current will be drawn from the transmitter. Connect the minus 22-volt lead to the terminal marked MUTE and the transmitter chassis to the terminal marked GND. Leave the XMT-REC switch on the REC position. When the transmitter is turned on or keyed, your NC-303 will automatically mute. Since the muting circuit is well filtered, no key clicks should be heard.

## 2.5 ANTENNA

A two-terminal strip is provided for connection of antennas fed by unbalanced transmission line systems. Usually the most efficient antenna is the one which has been tuned and adjusted for optimum transmitting results. For the 40-, 80- and 160-meter bands, a single wire antenna of between 15 and 40 feet should provide ample signal pickup. This antenna should be connected to terminal A, and a good electrical ground should be connected to terminal B. Switching the antenna from the transmitter to the receiver is most easily accomplished by means of a relay actuated by the RELAY terminals of your NC-303.

Any of the popular dipoles, beams etc. which are fed with 50- to 70 ohm coaxial cable will be ideal. In installations where it is desired to use an already existing antenna with a 300-ohm balanced feedline, an antenna coupler such as a balun can be used to match this antenna to the 70-ohm unbalanced input of your NC-303. The balun may be either a quarter-wave section of coax or a pair of balun coils.

## NOTE

If the receiver is used in close proximity to the transmitting equipment some provision must be made to short the antenna terminals to ground during transmitting periods to prevent damage to the antenna coils. This is most easily accomplished by means of a relay connected to the antenna terminals and ground. The relay should be located within six inches of the antenna terminal strip to prevent excessive pick-up.

A chassis hole is located close to the A-G terminal strip to permit attachment of a flange-mounted coax receptacle. Removal of the lead from terminal A and reconnection to the center terminal of the receptacle will then enable the user to utilize an antenna coax plug. Connect the coax to a coaxial plug which mates with the fitting selected for your NC-303. An alternate method is to connect the shield braid of the coax to terminal G and the inner conductor to terminal A. A good electrical ground should be used. This may be a convenient cold water pipe scraped clean of paint and oxidation or a suitable ground-rod driven into the earth as close as possible to your receiver location. The outstanding sensitivity and signal-to-noise characteristics of your NC-303 cannot be fully realized unless every effort is made to provide proper antenna and ground facilities.

## 2.6 CALIBRATOR SOCKET

The calibrator socket toward the rear of your receiver chassis is factory wired so that it is only necessary to plug in the National XCU-303 or XCU-300 crystal calibrator unit. The OFF-CAL-WWV switch on your front panel will then energize the calibrator when desired.

## 2.7 ACCESSORY SOCKET

This socket permits a variety of accessories to be used with your NC-303. Audio devices such as a crystal phono pickup may be connected to pins 5 and 6. Heater, B+, AVC and ground connections are available for external converters, etc. The receiver IF output is connected to pin 4 for use with SSB devices and the RF gain bus is brought to pin 1 for external control of RF gain.

## SECTION 3 OPERATION

The purpose of this section is to provide you with a clear and concise understanding of the operating techniques of your NC-303 to assist you in securing maximum satisfaction from the receiver. The design of the receiver circuits provides every feature necessary for outstanding performance but a thorough knowledge of correct operation is required to utilize these features to full advantage. For complete appreciation of your NC-303 READ THESE INSTRUCTIONS CAREFULLY.

### 3.1 CONTROLS

Complete utilization of the operating instructions is not possible without a thorough understanding of all front-panel devices. See Figure 3 for the location of all controls. The control designations used correspond to the markings on the receiver.

ANL (Automatic Noise Limiter) — The ANL control is used for CW and SSB as well as AM reception. This control incorporates a switch which turns the limiter off when the control is rotated to its maximum counter-clockwise position. With the receiver set for AM operation turning the control clockwise just enough to throw the switch places the AM limiter in operation. With the ANL control in this position the AM noise limiter is in full operation, and automatically maintains the best signal-to-noise ratio regardless of signal strength. This AM noise limiter is preset at the factory to clip at an optimum value of 40% to 50% modulation. Further rotation of the ANL control has no effect on AM reception.

With your receiver set up for CW or SSB operation, the clipping level of the CW-SSB limiter is manually set by the ANL control. Optimum noise clipping of

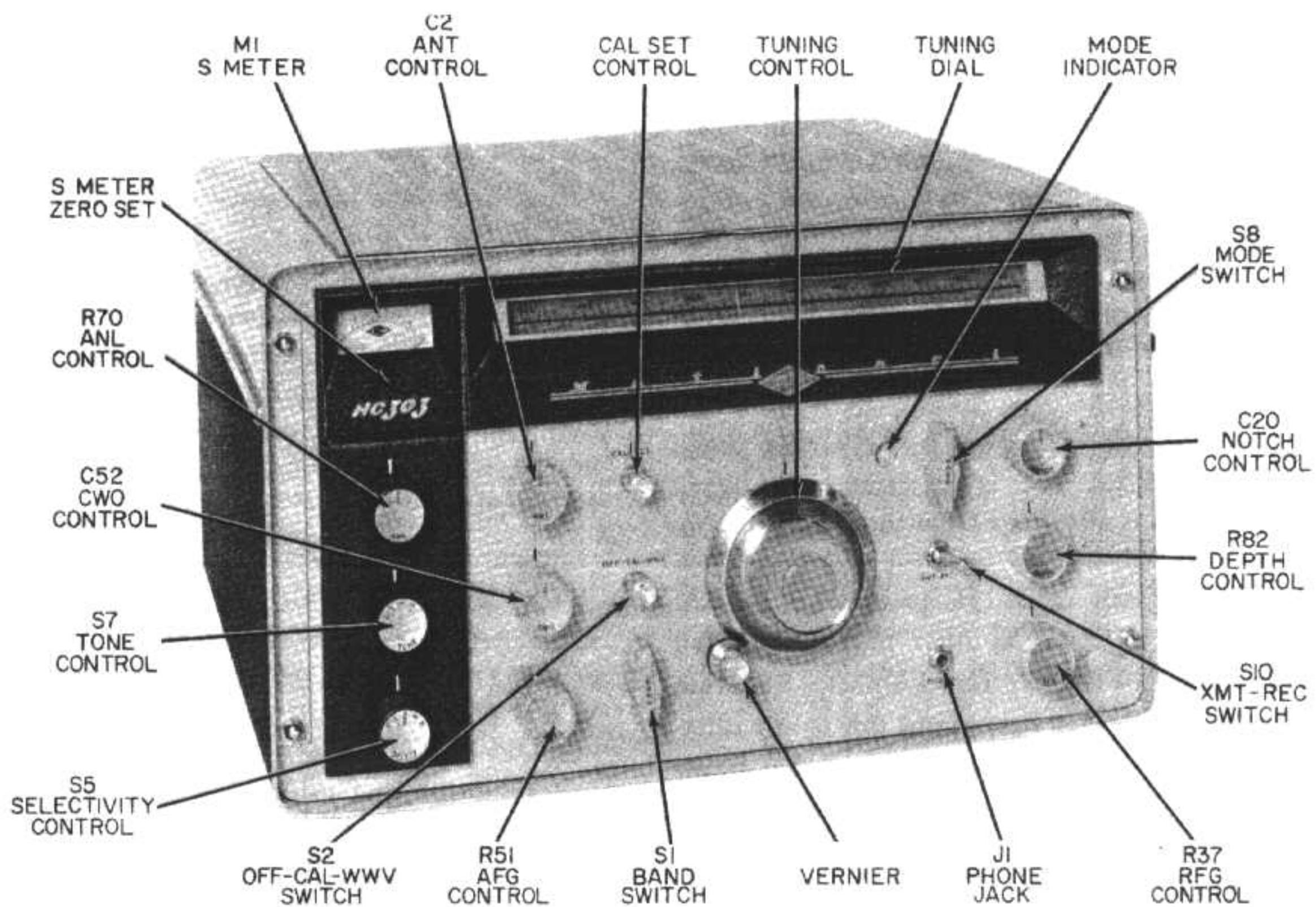


Figure 3. Front Panel Control Locations

CW and SSB signals will be obtained with the ANL control set between the 6 o'clock and 10 o'clock positions depending upon the signal strength of the received signal. The CW-SSB limiter is double-ended and clips both positive and negative noise peaks. Noise conditions will vary with localities, so the limiting level is a matter of personal choice.

**CAL-SET** (Dial Pointer Adjustment) — This control provides calibration correction for each band when used with an XCU-303 or XCU-300 crystal calibrator. With the mode switch at CW and the crystal calibrator switched on, tune your receiver to zero beat at any 100-kc point of the band, any slight error in dial reading may be corrected by turning the CAL-SET control to move the pointer to the desired 100-kc dial position. This is a mechanical adjustment of the dial pointer and in no way affects the receiver's oscillator frequency.

**ANT** (Antenna Trimmer) — This control is included to provide a means of matching the RF tuned circuits to varying antenna impedances. After the desired signal is selected, the antenna trimmer should be adjusted to produce maximum S-meter readings. If desired, the ANT can be peaked on noise without signal.

**MODE** — The MODE switch selects the mode of operation i.e., ACCESSORY, AM, CW, or SSB. The mode selected appears in the small round opening at the left of the switch knob. The AM position is used for normal amplitude-modulated transmissions. In the ACC position, the audio amplifier is connected to the accessory socket to permit use of the receiver with external accessories or as an amplifier for a phone-pick-up or similar audio device. In the CW position, the heterodyne detector is energized and AGC and S-meter circuits are disabled. In the SSB position, the heterodyne detector is used for carrier reinsertion and the special fast-attack-slow-release AGC and S-meter circuits are active.

**NOTCH** — This control tunes the rejection notch across the IF passband and is operative only when the DEPTH control is advanced from the OFF position. Turning the NOTCH control tunes the rejection notch continuously across the entire IF passband. In AM operation this type of rejection filter permits rejection of either the desired or the interfering signal. Rejection of either signal removes the heterodyne due to the interfering signal. The correct setting is the one that leaves the desired signal quality essentially unimpaired. If a wrong position is selected, the desired AM signal will be garbled or completely missing. For SSB reception it is impossible to reject the desired signal. Because of the very sharp (400-cps) IF selectivity bandwidth the NOTCH and DEPTH controls are not normally required

for CW reception when the SELECT control is in the S position.

**SELECT** — IF amplifier selectivity is determined by the position of this control. Position S provides the extremely-sharp selectivity required for CW reception on crowded bands. In this position, a selectivity bandwidth of 400 cps centered at 80 kc is obtained. Positions SB1 and SB2 allow instantaneous selection of sidebands for SSB and AM operation with the proper bandwidth necessary for high-quality interference-free reception. Positions SB1 and SB2 each have a bandwidth of 2000 cps and are centered on approximately 81.5 and 78.5 kc respectively. Position M provides the optimum bandwidth for good-quality interference-free AM reception. In this position, a bandwidth of 3500 cps centered on 80 kc is obtained. Position B allows high-quality reception where interference is not a problem and provides a wide bandwidth for net or VHF operation. The bandwidth in this position is 8000 cps centered on 80 kc.

**TONE** (HI-N-LO-PK) — Adjustment of the characteristics of the audio circuits is permitted by the TONE control. This control is a switch with four positions of audio response. The HI position attenuates low frequency tones in the audio signal. In the N position the audio is almost flat. The LO position attenuates high frequency tones in the audio signal. The PK position attenuates both low and high frequency tones and boosts middle frequency tones. The HI position noticeably increases the readability of AM and SSB signals in the presence of heavy noise interference. The PK position adds to the overall selectivity of the receiver in CW reception.

**CWO** — This control varies the pitch of the generated audio tone to suit the operator when receiving CW signals. During single-sideband operation, the control is set with the pointer straight up and all tuning is done with the SELECT control and the tuning knob. It is not necessary to move the CWO control when changing the IF selectivity.

**OFF-CAL-WWV** (Calibrate Switch) — If the XCU-303 or XCU-300 crystal calibrator is plugged into your receiver, this switch is used to turn the calibrator OFF or ON (CAL), or to set the calibrator to receive station WWV if the XCU-303 calibrator is used. The calibrator provides a crystal controlled test signal every 100 kilocycles so that dial calibration may be checked and, if necessary, corrected by means of the CAL-SET control. To receive station WWV with the XCU-303 calibrator, turn calibrate switch to WWV position, switch BAND control until 40-meter scale is visible on the slide-rule dial and tune to 7.07 mc (marked in red on dial scale). With the XCU-300 calibrator WWV signals cannot be

received, although the XCU-300 calibrator will continue to furnish the 100 kc test signal with the calibrate switch in the WWV position.

**TUNING** — The tuning knob provides a 40-to-1 ratio for ease in selecting the desired signal as indicated on the slide-rule dial. Frequency increases with clockwise rotation of the knob. The tuning knob has a rim-drive vernier which provides an additional 7 to 1 ratio to aid in fine tuning. Inward pressure against the vernier engages it with the tuning knob, pulling outward on the vernier disengages it. The tuning knob has a calibrated scale on its outer edge for logging purposes. **CAUTION:** Do not force the dial pointer against the extreme ends of the dial scale. Rough usage may upset calibration.

**XMT-REC** — This is a two-position toggle switch which may be set at XMT to mute the receiver during standby and/or transmitting periods. In addition, it will turn the transmitter on and off if the RELAY terminals at the rear of the receiver have been connected to provide this function. Since the XMT-REC switch performs its function in the audio and IF stages, normal operating voltages are maintained on the oscillators and all other frequency-critical circuits to ensure that no frequency drift will occur during standby periods.

**DEPTH** — This control activates the Q multiplieter and controls the depth of the rejection notch. For normal operation adjust the DEPTH and NOTCH controls for maximum rejection at the center of the IF passband and then use the NOTCH control only for removing interfering signals. If the unwanted signal is very strong, set the NOTCH control for rejection of unwanted signal and then adjust DEPTH control for still greater rejection. Repeat this procedure again for maximum rejection.

**AFG (Audio Frequency Gain Control)** — The function of this control is the adjustment of audio output level to suit the listener. Turning the control clockwise increases the volume; turning it counter-clockwise decreases the volume.

**BAND (Band Change Switch)** — This control is used to select the desired frequency band to be tuned. Gear reduction is employed in your NC-303 to assure a smooth working control and positive locking switch positions. For this reason the BAND control makes more than one revolution in switching through all 10 bands. The band to which the receiver is set is identified by the scale visible on the slide-rule dial since the dial and the BAND switch are mechanically coupled. Positive stops are provided at both ends of the BAND control travel.

**PHONES (Phone Jack)** — Headphones of the high-impedance type may be plugged into the PHONE jack

by using a standard two-circuit phone plug. There is no DC voltage associated with the headphone circuit. The loudspeaker is automatically silenced when the phone plug is inserted.

**RFG (RF Gain Control)** — The sensitivity of the receiver is adjusted by means of this control. It controls the gain of the RF amplifier and second IF stages. The AC switch which turns your NC-303 on and off is mounted on the RFG control. When this control is rotated to its maximum counter-clockwise position the AC power is shut off. Rotating the control slightly in the clockwise direction will actuate the switch, turning the receiver on and further clockwise rotation will increase the receiver sensitivity until maximum is reached at the full clockwise position.

### 3.2 SINGLE-SIDEBAND RECEPTION

The instructions in steps 1 through 18 adjust your NC-303 receiver for normal reception of SSB phone signals.

1. Set ANL control at OFF.
2. Set MODE switch at SSB.
3. Set DEPTH control at OFF.
4. Set TONE control at N.
5. Set OFF-CAL-WWV switch at OFF.
6. Set XMT-REC switch at REC.
7. Set SELECT control at M.
8. Set CWO control exactly at the front panel mark.
9. Set CAL-SET control at the front panel mark.
10. Set BAND switch to the desired frequency range as indicated by the slide-rule dial scale.
11. Turn RFG control slightly clockwise until switch clicks and dial lights come on. Allow at least two minutes for the tubes to reach operating temperature before proceeding.
12. Rotate the RFG control further clockwise until background noise causes the S-meter to read approximately 1 S-unit.
13. Set AFG control to produce the desired background noise level.
14. Turn ANT control to obtain maximum background noise and S-meter reading. Steps 12 and 13 may be repeated if desired.
15. Rotate TUNING control until the desired signal is located. Engage the VERNIER drive and slowly tune

the receiver across the desired signal until the audio output is normal and clearly understandable.

16. Set SELECT control to SB1 or SB2. In one position the signal level will increase and show improved signal-to-noise ratio. In the other position the signal level will be missing, or greatly attenuated. Select the position which produces the loudest signal.

17. Set AFG control to produce the desired listening level.

18. Set TONE control to the position giving the desired audio response.

19. To shut down the receiver, turn the RFG control fully counter-clockwise. Power is now removed from your entire receiver.

The AFG control should be used in most cases to adjust the audio output level. The RFG control setting obtained in Step 12 will permit accurate S-meter readings to be obtained on modulation peaks, and should normally not be changed unless operation is shifted to another band, where steps 12 through 17 should be repeated. Position SB1 provides upper sideband reception on the 160-, 80- and 40-meter bands; position SB2 for lower sideband signals on these bands. The sidebands are reversed on the 20-, 15-, 11- and 10-meter bands.

Various types of interference which may be encountered due to adverse receiving conditions can be minimized by adjusting the following controls in the manner described.

**Heterodyne Interference:** Turn DEPTH control clockwise to approximately 180°-200°. Turn NOTCH control to minimize heterodyne interference. Readjust DEPTH and NOTCH controls alternately until the heterodyne disappears. The quality of the desired signal will be essentially unimpaired.

**Atmospheric and Impulse Type Noise:** Turn ANL control clockwise until the best compromise between interference reduction and signal clipping is reached. For extremely heavy noise conditions it is often helpful to set the TONE control at HI.

### 3.3 AM PHONE RECEPTION

The instructions in steps 1 through 16 adjust the receiver for the normal reception of AM phone signals.

1. Set ANL control at OFF.
2. Set MODE switch at AM.
3. Set DEPTH control at OFF.
4. Set TONE control at N.
5. Set OFF-CAL-WWV switch at OFF.

6. Set XMT-REC switch at REC.
7. Set IF SELECT control at position M.

8. Set BAND switch to the desired frequency range as indicated by the slide-rule dial scale.

9. Set center dot on CAL-SET knob at the front panel mark.

10. Turn RFG control slightly clockwise. Power is now applied to the receiver. Allow at least two minutes for the tubes to reach operating temperature before proceeding.

11. Rotate the RFG control further clockwise until background noise causes the S-meter to read approximately 1 S-unit.

12. Turn AFG control to produce the desired background noise.

13. Rotate TUNING control until the desired signal is located. Adjust the TUNING control very carefully for maximum S-meter reading.

14. Turn ANT control to obtain maximum S-meter reading. This control may be set, in the absence of a signal, by adjusting it to obtain peak output from the background noise.

15. Set AFG control to produce the desired listening level.

16. Turn TONE control to a position giving the desired audio response.

The AFG control should be used in all cases to adjust the audio output level. The RFG control setting may require readjustment for true S-meter readings. Refer to paragraph 3.5. Position B of the SELECT control will minimize the amount of retuning necessary during net or roundtable reception.

Various types of interference which may be encountered due to adverse receiving conditions can be minimized by adjusting the following controls in the manner described.

**Heterodyne Interference:** Turn DEPTH control clockwise to approximately 180°-200°. Turn NOTCH control to minimize heterodyne interference. **CAUTION:** two points of minimum interference will usually be noted. One is the correct minimum, where the interfering carrier is rejected. The other minimum occurs when the desired carrier is rejected, which results in unintelligible output. Always select the minimum interference point that leaves the quality of the desired signal essentially unimpaired. Readjust NOTCH and DEPTH controls alternately until the heterodyne disappears.

**Atmospheric and Impulse Type Noise:** Turn the ANL control slightly clockwise until the switch clicks. The automatic AM noise limiter is now in operation and a definite reduction of noise interference will be noted. Further rotation of the ANL control will have no effect on AM signals. For extremely heavy noise conditions it is often helpful to set the TONE control at HI.

### 3.4 CW RECEPTION

The instructions in steps 1 through 18 adjust the receiver for normal reception of CW signals.

1. Set ANL control at OFF.
2. Set MODE switch at CW.
3. Set DEPTH control at OFF.
4. Set TONE control at N.
5. Set OFF-CAL-WWV switch at OFF.
6. Set XMT-REC switch at REC.
7. Set SELECT control at S.
8. Set AFG control fully clockwise.
9. Set CWO control at approximately 11 o'clock or 1 o'clock.
10. Set CAL-SET knob at the front panel mark.
11. Set BAND switch to the desired frequency range as indicated by the slide-rule dial scale.
12. Turn RFG control slightly clockwise until switch clicks and dial lights come on. Allow at least two minutes for the tubes to reach operating temperature before proceeding.
13. Rotate RFG control further clockwise until background noise is audible.
14. Turn ANT control to obtain maximum background noise level.
15. Rotate TUNING control until the desired signal is located.
16. Carefully peak the desired signal for maximum audio output. It is important to remember that the IF passband is only 400 cycles wide, so the TUNING control must be adjusted very slowly and carefully. The VERNIER drive may be engaged and used if desired.
17. Reset CWO control for desired beat note. The CWO control should be left in this position when turning in other CW signals.
18. Set RFG control to produce the desired signal level.

If CW operation with AGC and S-meter operation is desired, turn the MODE switch to SSB. Then advance the RFG control as indicated in 3.2 and use the AFG control to set the output level. Note that the fast-attack — slow-release AGC circuit automatically keeps the RF gain of the receiver at the proper level at all times.

Your NC-303 will exhibit pronounced single-signal properties which may be demonstrated by tuning the receiver to the other side of zero-beat so that the pitch is the same as before, and observing the marked reduction in output. The Q multiplier is not needed for CW reception because of the extreme sharpness of IF selectivity with the SELECT control in the S position.

An important aid to CW operation of an amateur station has been included in your NC-303. It is frequently desirable for the operator to monitor his own transmitted signal while sending CW. To accomplish this, two gain controls adjusted for two different signal levels are necessary. The additional control may be mounted on the station control panel adjacent to the transmitter controls or at any other convenient location. Connect the control as shown in Figure 2.

Adjust the external control to receive the incoming signal at the desired level and adjust the RFG control of the NC-303 for comfortable monitoring level. When using an external RF gain control the XMT-REC switch must be left at the REC position at all times.

Various types of interference which may be encountered due to adverse receiving conditions can be minimized by adjusting the following controls in the manner described.

**Heterodyne Interference:** Due to the extremely narrow IF bandpass in the S position, heterodyne interference is minimized. When such interference is encountered it can be reduced in the following manner: set the CWO control to produce the same beat note on the other side of zero beat. Note the new magnitude of heterodyne interference and choose the CWO setting that minimizes it. Engage the vernier and carefully tuning your receiver to produce the greatest signal-to-heterodyne ratio. It may be possible to zero beat the interfering heterodyne. Setting the TONE control to the HI, LO, or PK position will also prove helpful in minimizing heterodyne interference.

**Atmospheric and Impulse Type Noise:** Turn ANL control clockwise until best compromise between interference reduction and signal clipping is reached.

**Severe Fading:** The ANL control can also be used on CW to provide an almost constant signal level on severely fading signals. To utilize this feature, set the RFG control for desired signal level near the bottom of the fade. Use the ANL control to clip the CW signal slightly above the desired level. The clipped signals do not materially affect readability of the CW signal.

### 3.5 MEASUREMENT OF SIGNAL STRENGTH

Signal strength measurements referenced to the local ambient noise level are made by following the instructions given below. It should be noted that the S-meter of your NC-303 follows the average signal level very closely in all modes of operation and does not merely indicate the AGC characteristics of the receiver. Thus, the S-meter pointer may indicate zero between words of a single sideband transmission while the background noise remains low due to the long release time of the AVC.

1. Set RFG control fully clockwise and the MODE switch at **AM**.
2. Set SELECT switch to **M**.
3. Set DEPTH control to **OFF**.
4. Tune receiver to a band setting where no signal is heard so that the S-meter is reading background noise.

5. Set RFG control so that the meter reads halfway between 0 and S-1.

6. Tune in the desired signal. The S-meter will indicate the strength of the received signal in S-units from 1 to 9 or in decibels above the S-9 level from 0 to 40 db. These readings will remain accurate until the RFG control is moved or the receiver is switched to a different band.

The S-meter circuit compensator requires adjustment only when it is impossible to obtain a zero reading with no antenna connected and the RFG control turned fully counter-clockwise. See Section 4.4 for adjustment procedure.

Design of the S-meter actuating circuit is such that a signal stronger than that necessary for full-scale deflection cannot cause the meter pointer to come into violent contact with its stop pin thus preventing possible bending of the meter pointer.

When the MODE switch is in the SSB position, CW signal strength can be measured by following the procedures given in 3.4. Measurement of the signal strength of CW signals cannot be made with the MODE switch in the CW position.

With the AC switch on the RFG control set at OFF, or when the MODE switch is on CW, the S-meter pointer will return to its mechanical zero located on the right-hand end of the meter.

## SECTION 4 MAINTENANCE DATA

### 4.1 GENERAL

All circuits in your NC-303 receiver are carefully aligned before shipment using high-precision laboratory equipment to insure high accuracy. The quality of components used, together with careful design, makes any realignment unnecessary unless your receiver is tampered with, or certain part or tube replacements have been made. In no case should realignment be attempted unless conclusive tests indicate that such realignment is required. Even then it must be remembered that your NC-303 is a highly specialized instrument and should not be serviced or realigned by any individual who does not have a complete understanding of the functioning of the equipment and who has not had previous experi-

ence adjusting receivers of this type. In addition, because of the calibration accuracy and extreme bandspread of your NC-303 it is mandatory that adequate test equipment be used.

Complete alignment of the receiver can be divided into three steps as follows:

- (a) 2nd IF amplifier, Q multiplier and Product detector alignment.
- (b) 1st IF amplifier.
- (c) RF amplifier.

All circuits must be tuned in the above order when complete alignment is required.

## 4.2 2ND IF AMPLIFIER, Q MULTIPLIER AND HETERODYNE DETECTOR ALIGNMENT

The second intermediate frequency of your NC-303 must be aligned at exactly 80 kc. The signal generator used must be capable of being set at this frequency with great accuracy. The IF transformers are tuned by means of adjustable ferrite cores.

The IF alignment procedure is as follows (Disregard the BAND switch setting):

- (1) Connect the output lead of the signal generator to pin 7 of V3, the 6BE6 2nd converter tube, and connect the ground lead to chassis. Use a generator output connection which allows the generator output to be attenuated.
- (2) Set the MODE switch at AM.
- (3) Set the SELECT switch at position S.
- (4) Set the RFG control at its maximum clockwise position.
- (5) Set the XMT-REC switch at REC.
- (6) Set the DEPTH control at OFF. Turn the modulation of the signal generator off and set the frequency of the generator at EXACTLY 80 kc. Increase or decrease the generator output until the S-meter of the receiver indicates S-5.
- (7) Adjust L13, L12, L10, L9, L7 and L5 in that sequence to produce maximum S-meter reading. Each time a maximum is obtained for any one adjustment reduce the generator output to regain the S-5 reading. Failure to reduce the generator output may result in an overload condition and possible incorrect alignment. Carefully repeat the above procedure at least once to insure proper alignment. When the above procedure is followed, it is not necessary to disable the second oscillator or AGC.
- (8) To set the heterodyne detector oscillator, plug in headphones or connect a loudspeaker, set the MODE switch at CW and CWO knob at center (two marks aligned). Keep the signal generator set for exactly 80 kc. Adjust T8 for zero beat in headphones or loudspeaker.
- (9) The Q multiplier should be aligned after the second IF amplifier and heterodyne detector are aligned. Leave the signal generator set at exactly 80 kc, feed a signal to the signal grid of the second mixer (6BE6) and set the CWO control for a convenient beat note. Turn the DEPTH control on and set NOTCH control to mid position. Adjust the slug in the Q multiplier for maximum rejection of 80-*kc* signal as shown by

minimum output. It may also be necessary to adjust the DEPTH control to get maximum rejection.

The following adjustment is necessary when the tube in the Q multiplier is changed. Set the receiver for CW operation with no signal coming through the set and turn NOTCH control 90° counter-clockwise from mid position (lowest frequency). Advance DEPTH control to its maximum clockwise position. Lift up receiver cover and turn screwdriver adjustment on top of Q multiplier can clockwise until the Q multiplier breaks into oscillation. Then turn screwdriver adjustment slowly counter-clockwise until oscillation just ceases.

## 4.3 FIRST IF ALIGNMENT

Set the receiver for AM reception with the SELECT switch in the S position and the Q multiplier off. Apply an unmodulated signal from a signal generator tuned to approximately 2215 kc between center-section stator plates of main tuning capacitor and ground. Adjust the tuning and output of the signal generator for a maximum output reading of S-5 on the receiver S-meter. Once the tuning of the generator is set, the generator frequency should not be changed. Adjust the four slugs on the 2215-*kc* IF transformers T2 and T3 for maximum output as indicated on the S-meter. Reduce the output of signal generator to maintain a meter reading of S-5 as each slug is peaked. Once these adjustments have been made the 2215-*kc* IF is properly aligned.

## 4.4 RF AMPLIFIER

One of the outstanding features of your NC-303 is its accuracy of calibration. To maintain this precision, the signal source used for front-end alignment must have the accuracy of precision crystals. National's XCU-303 or XCU-300 crystal calibrators are recommended although any reliable secondary standard (crystal controlled) can be used. These calibrators can be used in conjunction with a standard signal generator to insure calibration accuracy. It is not necessary to move the signal generator from point to point because of the restricted frequency coverage of the receiver and the limits of the various alignment adjustments. Connect the signal generator to the antenna terminals using a 1/2-watt resistor of approximately 70 ohms between the hot lead and the antenna terminal. The generator may remain connected to this point for the remaining alignment adjustments. Leave the modulation of the generator shut off and proceed as follows:

- (1) Set the CAL-SET so that the dot on the knob is directly below the marking on the panel.
- (2) Set the BAND switch according to the Alignment Chart.

## ALIGNMENT CHART

STEP	BAND	ADJUST SIGNAL SOURCE TO:	SET RECEIVER TO:	ADJUST TO RECEIVE TEST SIGNAL	ADJUST FOR MAXIMUM OUTPUT
1	160	2 mc	2 mc	C70	
2	160	1.9 mc	1.9 mc		C68A
3	160	1.8 mc	1.8 mc	T9	
4	160	2 mc	2 mc	C70	Repeat steps 1, 3 and 4 if necessary
1	80	4 mc	4 mc	C71	
2	80	3.8 mc	3.8 mc		C68B
3	80	3.5 mc	3.5 mc	T12	
4	80	4 mc	4 mc	C71	Repeat steps 1, 3 and 4 if necessary
1	40	7.3 mc	7.3 mc	C72	
2	40	7.2 mc	7.2 mc		C68C
3	40	7 mc	7 mc	T15	
4	40	7.3 mc	7.3 mc	C72	Repeat steps 1, 3 and 4 if necessary
1	20	14.4 mc	14.4 mc	C73	
2	20	14.2 mc	14.2 mc		C68D
3	20	14.0 mc	14.0 mc	T18	
4	20	14.4 mc	14.4 mc	C73	Repeat steps 1, 3 and 4 if necessary
1	15	21.5 mc	21.5 mc	C74	
2	15	21.3 mc	21.3 mc		C69A
3	15	21.0 mc	21.0 mc	T21	
4	15	21.5 mc	21.5 mc	C74	Repeat steps 1, 3 and 4 if necessary
1	11	27.5 mc	27.5 mc	C75	
2	11	27.0 mc	27.0 mc		C69B
3	11	26.5 mc	26.5 mc	T24	
4	11	27.5 mc	27.5 mc	C75	Repeat steps 1, 3 and 4 if necessary
1	10	29.7 mc	29.7 mc	C76	
2	10	29.0 mc	29.0 mc		C69C
3	10	28 mc	28 mc	T27	
4	10	29.7 mc	29.7 mc	C76	Repeat steps 1, 3 and 4 if necessary
1	X	35 mc	225 mc	C77	
2	X	33 mc	223 mc		C69D
3	X	30 mc	220 mc	T30	
4	X	35 mc	225 mc	C77	Repeat steps 1, 3 and 4 if necessary

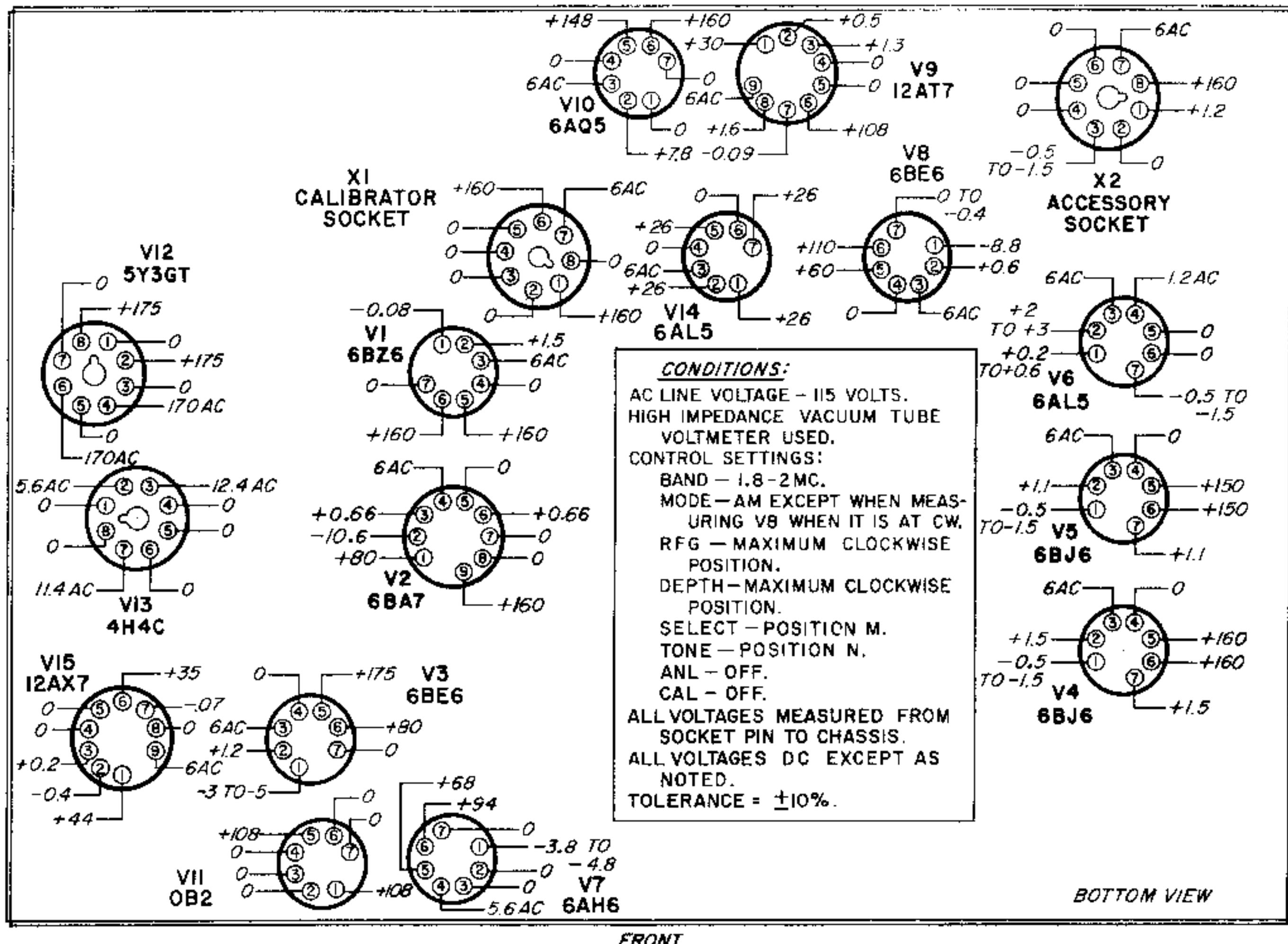


Figure 4. Tube Socket Voltages

- (3) Set the MODE switch at AM.
- (4) Set the DEPTH at OFF.
- (5) Set the SELECT control at position S.
- (6) Set the RFG control fully clockwise.

The S-meter of the receiver will be used as the indicating instrument for the ensuing procedures and, at all times, the output of the signal generator must be adjusted to produce an S-meter reading of approximately S-5. When the XCU-303 or XCU-300 is used, the RFG control can be used to regulate the signal strength.

Make all adjustments in the order set forth in the Alignment Chart. The inductance adjustments are made by moving the small loop of wire inside the oscillator coil forms, using an insulated alignment tool or a small diameter bakelite rod. Because of the 2215-kc first IF

and the limited range of the trimmers, images will not be readable on your NC-303 so no special precautions need be taken in this regard.

#### 4.4 S-METER ADJUSTMENT

The S-meter balancing resistor R44 is used to obtain a zero meter reading in the absence of signal input to the receiver. To make this adjustment set the controls as follows: Set the RFG control at mid-range. Set the MODE switch at AM. Set the AFG at any position. Disconnect or short the antenna connections. Adjust the S-meter balancing resistor R44 to produce a 0 reading on the S-meter. This is a screwdriver adjustment located on top of the chassis.

#### 4.5 VOLTAGE DATA

The voltage measurements on Figure 4 will facilitate any servicing which might be required on your NC-303.

## 4.6 DIAL CORD STRINGING

In the event of breakage of the dial scale actuating cord or the dial pointer cord, the instructions shown on Figure 5 should be studied with care before attempting replacement. Failure to carry out these instructions correctly will result in incorrect indications of band setting and frequency. The dial scale in view at the front panel MUST correspond to the frequency range being tuned.

## 4.7 TUBE REPLACEMENT

Tubes which become weak or defective should be replaced. In the case of the 4H4-C current regulator, a type 6V6 may be used as a temporary substitute. This substitution will sacrifice some of the current regulating qualities provided by the 4H4-C but will keep the receiver operative. Type 4H4-C regulators are not generally available at most supply houses. A replacement can be obtained from National Co. or any National Co. authorized service station. A type 4H4 will not provide the required regulating action.

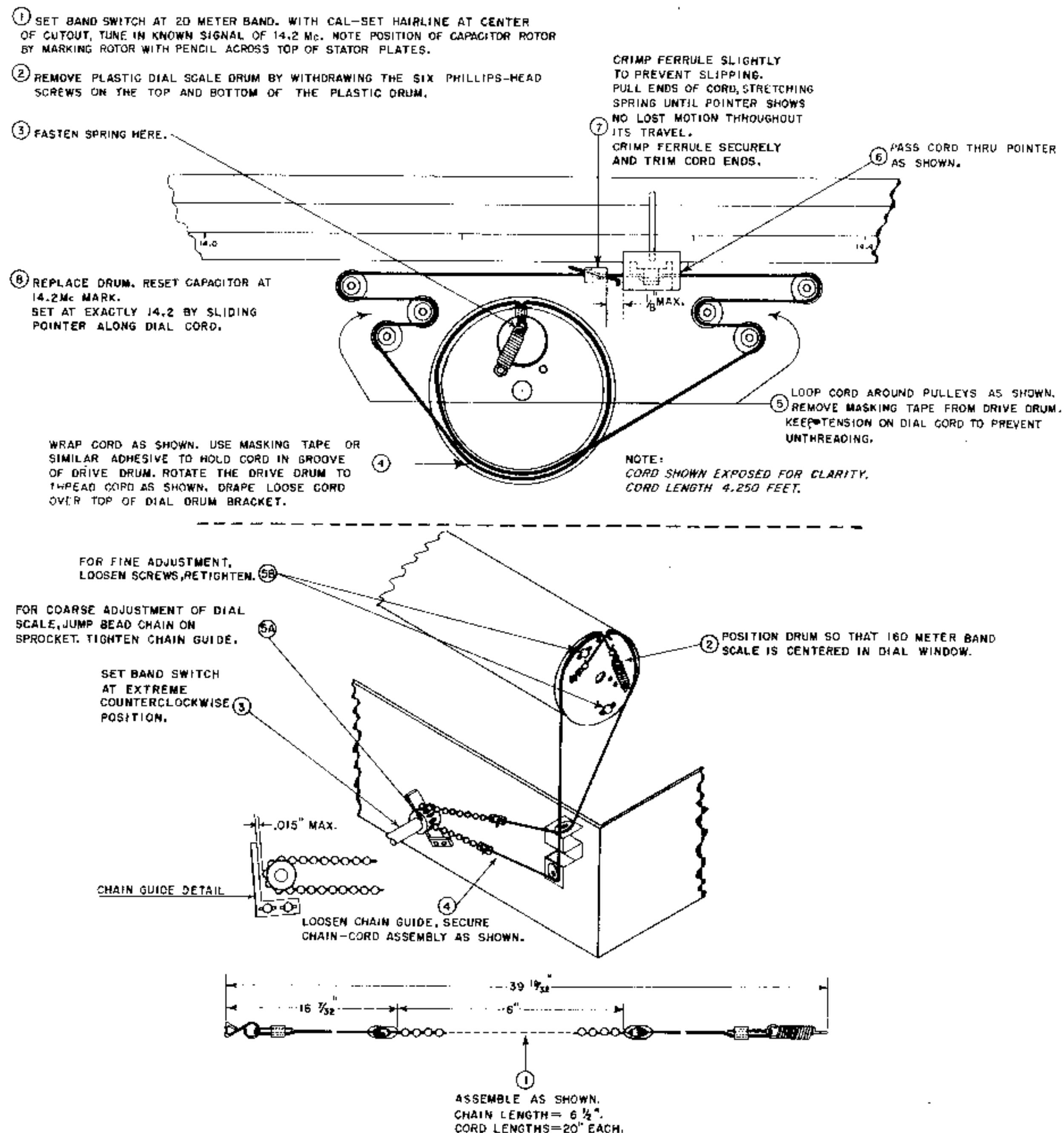


Figure 5. Cord Stringing Guide

## NC-303 PARTS LIST

### CAPACITORS

SYM-BOL	DESCRIPTION	NATCO TYPE
	All capacitors ±10%, 500 vdcw unless otherwise noted.	
C1	Air Variable: 3 sections	C11779
C1A	7.4-40.3 mmf, part of C1	
C1B	7.4-40.3, mmf, part of C1	
C1C	14.4-80.7 mmf, part of C1	
C2	Antenna Trimmer	A12502
C3	Ceramic: 100 mmf	D-825-C-304
C4	Disc: 0.01 mfd, 500 vdcw	2-C14-Z5V-103-GMV
C5	Disc: 0.01 mfd, 500 vdcw	2-C14-Z5V-103-GMV
C6	Mica: 1000 mmf	NCS-19-102-K5
C7	Disc: 0.01 mfd, 500 vdcw	2-C14-25V-103-GMV
C8	Mica: 470 mmf	NCS-19-471-K5
C9	Disc: 0.01 mfd -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV
C10	Disc: 0.01 mfd -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV
C11	Ceramic: 100 mmf ±5%, 300 vdcw	CM-15-C-101-J
C12	Ceramic: 100 mmf ±5%, 300 vdcw	CM-15-C-101-J
C13	Ceramic: 100 mmf ±5%, 300 vdcw	CM-15-C-101-J
C14	Ceramic: 100 mmf ±5%, 300 vdcw	CM-15-C-101-J
C15	Mica: 33 mmf	NCS-15-330-K-5
C16	Paper: 0.01 mfd ±20%, 400 vdcw	NCP-4-103-M
C17	Disc: 0.01 mmf -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV

SYM-BOL	DESCRIPTION	NATCO TYPE
C18	Paper: 0.022 mmf ±10%, 400 vdcw	NCP-2-223-K
C19	Disc: 0.01 mmf -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV
C20	Trimmer, Air: 100 mmf	A12501
C21	Mica: 680 mmf ±5%, 500 vdcw	NCS-19-681-J-5
C22	Mica: 120 mfd ±2%, 300 vdcw	NCS-15-121-G-3
C23	Mica: 150 mfd ±2%, 300 vdcw	NCS-15-151-G-3
C24	Ceramic: 10 mmf ±1 mmf, 500 vdcw	CCC-21-SL-100-F
C25	Mica: 470 mmf	NCS-19-471-K5
C26	Disc: 0.01 mfd -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV
C27	Disc: 0.005 mfd	2-C14-Z5P-502-K
C28	Paper: .047 mfd ±20%, 400 vdcw	NCP-4-473-M
C29	Mica: 270 mmf ±5%, 300 vdcw	CM-15-C-271-J
C30	Disc: 0.01 mfd -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV
C31	Disc: 0.01 mfd -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV
C32	Paper: .047 mfd ±20%, 400 vdcw	NCP-4-473-M
C33	Ceramic: 10 mmf ±1 mmf, 500 vdcw	CCC-20-SL-100-F
C34	Mica: 150 mmf ±2%, 300 vdcw	NCS-15-151-G-3
C35	Mica: 150 mmf ±2%, 300 vdcw	NCS-15-151-G-3
C36	Electrolytic: 8 mfd, 250 vdcw	E338-34
C37	Not Used	

PARTS LIST (CONT'D)

CAPACITORS (CONT'D)

SYM-BOL	DESCRIPTION	NATCO TYPE	SYM-BOL	DESCRIPTION	NATCO TYPE
C38	Paper: 0.047 mfd ±20%, 400 vdcw	NCP-4-473-M	C62	Electrolytic: 40-40-40-20 mfd, 250 vdcw	C19458-3
C39	Paper: 0.047 mfd ±20%, 400 vdcw	NCP-4-473-M	C63	Mica: .001 mfd ±20%, 1000 vdcw	RCM-30-B-102-M-10
C40	Paper: 0.1 mfd ±20%, 400 vdcw	NCP-4-104-M	C64	Ceramic: 4 mmf ±0.2 mmf	CCC-20-CL-040-C
C41	Disc: 0.01 mfd -0% +100%, 500 vdcw	2-C14-Z5V-103-GMV	C65	Mica: 0.001 mfd ±20%, 1000	RCM-30-B-102-M-10
C42	Mica: 220 mmf ±5%, 300 vdcw	RCM-15-B-221-J-3	C66	Mica: 0.001 mfd ±20%, 1000 vdcw	RCM-30-B-102-M-10
C43	Mica: 150 mmf ±2%, 300 vdcw	NCS-15-151-G-3	C67	Disc: 0.01 mfd, 500 vdcw	2-C14-Z5V-103-GMV
C44	Mica: 150 mmf ±2%, 300 vdcw	NCS-15-151-G-3	C68	Mica Variable: 4 sections, each 5-80 mmf	A12493
C45	Not Used		C68A	Part of C68	
C46	Not Used		C68B	Part of C68	
C47	Ceramic: 240 mmf ±2%, 300 vdcw	A14157	C68C	Part of C68	
C48	Ceramic: 12 mmf ±5%, 500 vdcw	CC-20-UJ-120-J	C68D	Part of C68	
C49	Ceramic: 15 mmf	D825D-467	C69	Mica Variable: 4 sections, each 5-80 mmf	A12493
C50	Mica: 470 mmf	J665-56	C69A	Part of C69	
C51	Ceramic: 0.01 mfd +100% -0%, 500 vdcw	K946-2	C69B	Part of C69	
C52	Air Variable: 12-100 mmf	A12501	C69C	Part of C69	
C53	Mica: 470 mmf	J665-56	C69D	Part of C69	
C54	Ceramic: 100 mmf	D825C-304	C70	Air Variable: 2.8-19.7 mmf	A12744
C55	Mica: 33 mmf	NCS-19-330-K-5	C71	Air Variable: 2.8-19.7 mmf	A12744
C56	Paper: 0.01 mfd ±20%, 400 vdcw	NCP-4-103-M	C72	Air Variable: 2.8-19.7 mmf	A12744
C57	Ceramic: 47 mmf	CCC-20-SL-470-K	C73	Air Variable: 2.8-19.7 mmf	A12744
C58	Mica: 3600 mmf ±5%, 300 vdcw	NCS-19-362-J-3	C74	Air Variable: 2.8-19.7 mmf	A12744
C59	Mica: 470 mmf ±10%, 500 vdcw	NCS-19-471-K-5	C75	Air Variable: 2.8-19.7 mmf	A12744
C60	Paper: 0.01 mfd ±20%, 400 vdcw	NCP-4-103-M	C76	Air Variable: 2.8-19.7 mmf	A12744
C61	Paper: 0.47 mfd ±20%, 200 vdcw	NCP-2-474-M	C77	Air Variable: 2.8-19.7 mmf	A12744

PARTS LIST (CONT'D)

CAPACITORS (CONT'D)

SYM-BOL	DESCRIPTION	NATCO TYPE
C78	Paper: 0.022 mfd $\pm 10\%$ , 400 vdcw	NCEP-223-K-4
C79	Not Used	
C80	Not Used	
C81	Not Used	
C82	Ceramic: 100 mmf $\pm 5\%$ , 500 vdcw	D825C-342
C83	Mica: .001 mfd	NCS-19-102-K-5
C84	Ceramic: 0.005 mfd $+100\% -0\%$ , 500 vdcw	K946-1
C85	Ceramic: 15 mmf	D825D-467
C86	Mica, Variable: 3.5-35 mmf	A12312
C87	Paper: 0.22 mfd $\pm 20\%$ , 400 vdcw	NCP-4-224-M
C88	Ceramic: 15 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-150-J
C89	Ceramic: 10 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-100-J
C90	Ceramic: 12 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-120-J
C91	Ceramic: 12 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-120-J
C92	Ceramic: 10 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-100-J
C93	Ceramic: 15 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-150-J
C94	Paper: 0.033 mfd $\pm 10\%$ , 200 vdcw	NCEP-333-K-2
C95	Mica: 910 mmf $\pm 5\%$ , 100 vdcw	NCS-15-911-J-1
C96	Mica: 3600 mmf $\pm 5\%$ , 300 vdcw	NCS-19-362-J-3
C97	Mica: 6200 mmf $\pm 2\%$ , 100 vdcw	NCS-20-622-G-1
C98	Ceramic: 4 mmf $\pm .2$ mmf, 500 vdcw	CCC-20-CH-040-C
C99	Ceramic: 4 mmf $\pm .2$ mmf, 500 vdcw	CCC-20-CH-040-C
C100	Ceramic: 15 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-150-J

SYM-BOL	DESCRIPTION	NATCO TYPE
C101	Ceramic: 10 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-100-J
C102	Ceramic: 12 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-120-J
C103	Paper: .033 mfd $\pm 10\%$ , 200 vdcw	NCEP-333-K-2
C104	Mica: 6200 mmf $\pm 2\%$ , 100 vdcw	NCS-20-622-G-1
C105	Mica: 3600 mmf $\pm 5\%$ , 300 vdcw	NCS-19-362-J-3
C106	Mica: 1000 mmf $\pm 5\%$ , 300 vdcw	NCS-19-102-J-3
C107	Ceramic: 12 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-120-J
C108	Ceramic: 10 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-100-J
C109	Ceramic: 15 mmf $\pm 5\%$ , 500 vdcw	CCC-20-SL-150-J
C110	Ceramic: 4 mmf $\pm 0.2$ mmf	CCC-20-CH-040-C
C111	Ceramic: 4 mmf $\pm 0.2$ mmf	CCC-20-CH-040-C
C112	Ceramic: 15 mmf $\pm 0.2$ mmf	CCC-20-SL-150-J
C113	Ceramic: 10 mmf $\pm 0.2$ mmf	CCC-20-SL-100-J
C114	Ceramic: 12 mmf $\pm 0.2$ mmf	CCC-20-SL-120-J
C115		
C116		
C117	Mica: 2700 mmf $\pm 5\%$ , 300 vdcw	NCS-19-272-J-3
C118	Mica: 1000 mmf $\pm 5\%$ , 300 vdcw	NCS-19-102-J-3
C119	Ceramic: 12 mmf $\pm 0.2$ mmf, 500 vdcw	CCC-20-SL-120-J
C120	Ceramic: 10 mmf $\pm 0.2$ mmf, 500 vdcw	CCC-20-SL-100-J
C121	Ceramic: 15 mmf $\pm 0.2$ mmf, 500 vdcw	CCC-20-SL-150-J

PARTS LIST (CONT'D)

CAPACITORS (CONT'D)

SYM-BOL	DESCRIPTION	NATCO TYPE
C122	Ceramic: 4 mmf $\pm 0.2$ mmf, 500 vdcw	CCC-20-CH-040-C
C123	Ceramic: 4 mmf $\pm 0.2$ mmf, 500 vdcw	CCC-20-CH-040-C
C124	Disc: 0.01 mfd, $-0\%$ $+100\%$ , 500 vdcw	2-C14-Z5V-103-GMV
C125	Mica: 1000 mmf $\pm 10\%$ , 500 vdcw	NCS-20-102-K-5

SYM-BOL	DESCRIPTION	NATCO TYPE
C126	Electrolytic: 1 mfd, 450 vdcw	E-338-10
C127	Paper: 0.1 mfd $\pm 20\%$ , 200 vdcw	NCP-2-104-M
C128	Paper: 0.1 mfd $\pm 20\%$ , 200 vdcw	NCP-2-104-M
C129	Disc: 0.01 mfd, $-0\%$ $+100\%$ , 500 vdcw	2-C14-Z5V-103-GMV
C130	1 mfd $\pm 20\%$ , 50vdcw	B25548

RESISTORS

	10% tolerance $\frac{1}{2}$ watt unless otherwise noted.	
R1	Fixed: 1 megohm	RC-20-BF-105-K
R2	Fixed: 33 ohms $\pm 20\%$ , $\frac{1}{2}$ w	RC-20-BF-330-M
R3	Fixed: 150 ohms	RC-20-BF-151-K
R4	Fixed: 180 ohms	RC-20-BF-181-K
R5	Fixed: 47,000 ohms	RC-20-BF-473-K
R6	Fixed: 220,000 ohms $\pm 20\%$ , $\frac{1}{2}$ w	RC-20-BF-224-M
R7	Fixed: 180 ohms	RC-20-BF-181-K
R8	Fixed: 22,000 ohms	RC-20-BF-223-K
R9	Fixed: 220 ohms	RC-20-BF-221-K
R10	Fixed: 100,000 ohms	RC-20-BF-104-K
R11	Fixed: 6,800 ohms	RC-20-BF-682-K
R12	Fixed: 2,200 ohms	RC-20-BF-222-K
R13	Fixed: 68 ohms $\pm 5\%$ , $\frac{1}{2}$ w	RC-20-BF-680-J
R14	Fixed: 330 ohms $\pm 5\%$ , $\frac{1}{2}$ w	RC-20-BF-331-J
R15	Fixed: 12,000 ohms	RC-20-BF-123-K
R16	Fixed: 1 megohm	RC-20-BF-105-K
R17	Fixed: 120-1200 ohms (value individually chosen to meet requirements of each receiver).	RC-20-BF( )K

R18	Fixed: 1 megohm	RC-20-BF-105-K
R19	Fixed: 1 megohm	RC-20-BF-105-K
R20	Fixed: 100 ohms $\pm 5\%$ , $\frac{1}{2}$ w	RC-20-BF-101-J
R21	Fixed: 430 ohms $\pm 5\%$ , $\frac{1}{2}$ w	RC-20-BF-431-J
R22	Fixed: 120 ohms	RC-20-BF-121-K
R23	Fixed: 2200 ohms	RC-20-BF-222-K
R24	Fixed: 1 megohm	RC-20-BF-105-K
R25	Fixed: 56 ohms $\pm 5\%$ , $\frac{1}{2}$ w	RC-20-BF-560-J
R26	Fixed: 1200 ohms $\pm 5\%$ , $\frac{1}{2}$ w	RC-20-BF-122-J
R27	Fixed: 100,000 ohms	RC-20-BF-104-K
R28	Fixed: 680,000 ohms	RC-20-BF-684-K
R29	Fixed: 1 megohm	RC-20-BF-105-K
R30	Fixed: 27,000 ohms	RC-20-BF-273-K
R31	Fixed: 100,000 ohms	J569-49
R32	Fixed: 100 ohms	J569-13
R33	Fixed: 10,000 ohms	J569-37
R34	Fixed: 10,000 ohms	J569-37
R35	Fixed: 180 ohms $\pm 5\%$ , 5 w	E959-26
R36	Fixed: 39,000 ohms $\pm 10\%$ , 2 w	RC-42-BF-393-K
R37	Variable: 10,000 ohms (with SPST switch)	B23483

PARTS LIST (CONT'D)

RESISTORS (CONT'D)

SYM-BOL	DESCRIPTION	NATCO TYPE
R38	Fixed: 68,000 ohms ±20%, 1/2 w	RC-20-BF-683-M
R39	Fixed: 100,000 ohms	J569-49
R40	Fixed: 68,000 ohms ±20%, 1/2 w	RC-20-BF-683-M
R41	Fixed: 820 ohms	RC-20-BF-821-K
R42	Fixed: 270,000 ohms	RC-20-BF-274-K
R43	Fixed: 33,000 ohms	RC-20-BF-333-K
R44	Variable, wire-wound 1,000 ohms	A12166
R45	Fixed: 3300 ohms	RC-20-BF-332-K
R46	Fixed: 120 ohms	RC-20-BF-121-K
R47	Not Used	
R48	Fixed: 270,000 ohms ±20%, 1/2 w	RC-20-BF-274-K
R49	Fixed: 470,000 ohms ±20%, 1/2 w	RC-20-BF-474-M
R50	Fixed: 470,000 ohms ±20%, 1/2 w	RC-20-BF-474-M
R51	Variable: 1 megohm	B23484
R52	Fixed: 270 ohms ±10%, 2 w	RC-42-BF-271-K
R53	Fixed: 33 ohms ±20%, 2 w	RC-42-BF-330-M
R54	Fixed: 10,000 ohms	RC-20-BF-103-K
R55	Fixed: 470,000 ohms	RC-20-BF-474-K
R56	Fixed: 10,000 ohms ±20%, 1/2 w	RC-20-BF-103-M
R57	Fixed: 4.3 ohms ±5%, 1 w	K098-48
R58	Fixed: 4.7 megohms	RC-20-BF-475-K
R59	Fixed: 10,000 ohms	RC-20-BF-103-K
R60	Fixed: 100 ohms ±20%, 1/2 w	RC-20-BF-101-M
R61	Fixed: 100,000 ohms	RC-20-BF-104-K
R62	Fixed: 150 ohms ±10%, 2 w	RC-42-BF-151-K

SYM-BOL	DESCRIPTION	NATCO TYPE
R63	Fixed: 2.2 ohms ±10%, 1 w	K098-24
R64	Fixed: 150 ohms ±10%, 2 w	RC-42-BF-151-K
R65	Fixed: 1500 ohms ±5%, 1/2 w	RC-20-BF-152-J
R66	Fixed: 1000 ohms ±5%, 1/2 w	RC-20-BF-102-J
R67	Fixed: 220,000 ohms	RC-20-BF-224-K
R68	Fixed: 10,000 ohms	RC-20-BF-103-M
R69	Fixed: 220,000 ohms	RC-20-BF-224-K
R70	Variable: 100,000 ohms including S6	A13597-2
R71	Fixed: 1800 ohms	RC-20-BF-182-K
R72	Fixed: 470,000 ohms	RC-20-BF-474-K
R73	Fixed: 100,000 ohms	RC-20-BF-104-K
R74	Fixed: 220,000 ohms	RC-20-BF-224-K
R75	Fixed: 10 ohms	RC-20-BF-152-K
R76	Fixed: 1500 ohms	RC-20-BF-152-K
R77	Fixed: 47,000 ohms	RC-20-BF-474-K
R78	Fixed: 27,000 ohms ±5%, 1/2 w	RC-20-BF-274-J
R79	Fixed: 68 ohms	RC-20-BF-680-K
R80	Fixed: 47,000 ohms	RC-20-BF-474-K
R81	Fixed: 4700 ohms	RC-20-BF-472-K
R82	Variable: 50,000 ohms including S4	B23425
R83	Fixed: 68,000 ohms	RC-20-BF-683-K
R84	Variable, wire-wound: 100,000 ohms	B23425
R85	Fixed: 4700 ohms	RC-20-BF-472-K
R86	Fixed: 68,000 ohms	RC-20-BF-683-K
R87	Fixed: 4700 ohms	RC-20-BF-472-K

PARTS LIST (CONT'D)

MISCELLANEOUS

SYM-BOL	DESCRIPTION	NATCO TYPE	SYM-BOL	DESCRIPTION	NATCO TYPE
E1	Knob: ANL	B23092	L5	Inductor, variable iron core, 80 kc	B12415
E2	Knob: Tone	B23079	L6	Inductor, variable iron core, 80 kc, Q multiplier	C23320
E3	Knob: Select	B23080	L7	Inductor, variable iron core, 80 kc	B12414
E4	Knob: Zero	A23275	L8	Not Used	
E5	Knob: CWO	B23082	L9	Inductor, variable iron core, 80 kc	B12414
E6	Knob: AFG	B11805	L10	Inductor, variable iron core, 80 kc	B12414
E7	Knob: Antenna Trimmer	B23083	L11	Not Used	
E8	Knob: OFF-CAL	A23275	L12	Inductor, variable iron core, 80 kc	B12414
E9	Knob: Band Switch	C11916-2	L13	Inductor, variable iron core, 80 kc	B12414
E10	Knob: Main Tuning	B13599-2	L14	Not Used	
E11	Knob: Mode	C11917-2	L15	RF Choke; 750 microhenries	SA-2868
E12	Knob: Depth	B23078	L16	Inductor, variable iron core, part of T6	
E13	Knob: Notch	B23081	L17	Not Used	
E14	Knob: RFG	B11806	L18	Inductor, 20 meter image trap	B16653
F1	Fuse: 2 amps, 250 v	F135-4	M1	S meter: 0-1 ma, illuminated	C12323
I1	Lamp, S Meter: type 47	A12285	O1	Dial Assembly	C12713
I2	Lamp, Dial: type 47	A12285	O2	Calibrated Dial	C11564-2
I3	Lamp, Dial: type 47	A12285	O3	Dial Mounting Drum	C11756
I4	Lamp, Dial: type 47	A12285	O4	Dial Pointer	A11814
J1	Phone Jack	A12241	O5	Dial Cord Assembly	A11966
J2	Converter Input Jack	A11998	O6	Dial Drum Cord Assembly	B13000
L1	RF Choke: 4 microhenries	B14904	P1	A.C. Power Cord and Plug	B22132-4
L2A	Inductor, Variable iron core; T3 primary; part of T3				
L2B	Inductor, variable iron core; T3 secondary; part of T3				
L3A	Inductor, variable iron core; T4 primary; part of T4				
L3B	Inductor, variable iron core; T4 secondary; part of T4				
L4	Not Used				

PARTS LIST (CONT'D)

MISCELLANEOUS (CONT'D)

SYM-BOL	DESCRIPTION	NATCO TYPE	SYM-BOL	DESCRIPTION	NATCO TYPE
S1	Band Switch: 8 wafers, 13 poles, 8 positions		S6	Limiter Switch: SPDT; mounted on R70	
S1A	Wafer: 2 poles, 8 positions	B12376	S7	Tone Switch: 1 wafer, 1 pole, 4 positions	B23006
S1B	Wafer: 2 poles, 8 positions	B12373	S8	Mode Switch, 1 wafer	B12371-2
S1C	Wafer: 1 pole, 8 positions	B12372	S9	A.C. Switch: SPST; mounted on R37	
S1D	Wafer: 1 pole, 8 positions	B12372	S10	Smit-Rec Switch, DPDT toggle	A13663-2
S1E	Wafer: 1 pole, 8 positions	B12372	T1	Power Transformer: primary 115 volts 50/60 cycles	B13647-2
S1F	Wafer: 2 poles, 8 positions	B12373	T2	Output transformer	B19435-E
S1G	Wafer: 2 poles, 8 positions	B12374	T3	IF Transformer: 2215 kc	C23323
S1H	Wafer: 2 poles, 8 positions	B12375	T4	IF Transformer: 2215 kc	C23323
S2	Calibrate Switch: 1 wafer, 1 pole, 3 positions	B23246	T5	Not Used	
S3	Not Used		T6	Product Detector Oscillator Transformer	B12650
S4	Switch: SPST, closed in CCW position mounted on R82		T7	Antenna Transformer: 160 meter band	B15294
S5	IF Selectivity Switch: 6 wafers, 24 poles, 5 positions		T8	1st Mixer Transformer: 160 meter band	B15294
S5A	Wafer: 4 poles, 5 positions	B23386	T9	1st Oscillator Transformer: 160 meter band	B14906
S5B	Wafer: 4 poles, 5 positions	B23387	T10	Antenna Transformer: 80 meter band	B15295
S5C	Wafer: 4 poles, 5 positions	B23386	T11	1st Mixer Transformer: 80 meter band	B15296
S5D	Wafer: 4 poles, 5 positions	B23387	T12	1st Oscillator Transformer: 80 meter band	B14909
S5E	Wafer: 4 poles, 5 positions	B23386	T13	Antenna Transformer: 40 meter band	B15297
S5F	Wafer: 4 poles, 5 positions	B23387	T14	1st Mixer Transformer: 40 meter band	B15298

PARTS LIST (CONT'D)

MISCELLANEOUS (CONT'D)

SYM-BOL	DESCRIPTION	NATCO TYPE	SYM-BOL	DESCRIPTION	NATCO TYPE
T15	1st Oscillator Transformer: 40 meter band	B14908	TB1	Antenna Terminal Board	E265-27
T16	Antenna Transformer: 20 meter band	B15300	TB2	Speaker Terminal Board	A12617
T17	1st Mixer Transformer: 20 meter band	B15299	TB3	Relay Terminal Board	A12616
T18	1st Oscillator Transformer: 20 meter band	B14910	TB4	Standby-Mute Terminal Board	A12615
T19	Antenna Transformer: 15 meter band	B15302	V1	Tube: type 6BZ6	
T20	1st Mixer Transformer: 15 meter band	B15301	V2	Tube: type 6BA7	
T21	1st Oscillator Transformer: 15 meter band	B14905	V3	Tube type 6BE6	
T22	Antenna Transformer: 11 meter band	B15304	V4	Tube: type 6BJ6	
T23	1st Mixer Transformer: 11 meter band	B15303	V5	Tube: type 6BJ6	
T24	1st Oscillator Transformer: 11 meter band	B14907	V6	Tube: type 6AL5	
T25	Antenna Transformer: 10 meter band	B15305	V7	Tube: type 6AH6	
T26	1st Mixer Transformer: 10 meter band	B15306	V8	Tube: type 6BE6	
T27	1st Oscillator Transformer: 10 meter band	B14812	V9	Tube: type 12AT7	
T28	Antenna Transformer: X band	B15307	V10	Tube: type 6AQ5	
T29	1st Mixer Transformer: X band	B15308	V11	Tube: type OB2	
T30	1st Oscillator Transformer: X band	B14911	V12	Tube: type 5Y3	
			V13	Tube: type 4H4-C	
			V14	Tube: type 6AL5	
			V15	Tube: type 12AX7	
			X1	CR1 Silicon Diode: type 1N1692	
			X2	Crystal Calibrator Socket	A12831
			X3	Accessory Socket	A12831
			X4	S Meter Lamp Socket	A12284
			X5	Dial Light Socket	A11721
			X6	Dial Light Socket	A11721
			X7	Fuseholder	A12613
			Y1	Crystal, Quartz: 2295 kc	B23482

## INSTRUCTIONS FOR THE NATIONAL XCU-303 DELUXE CRYSTAL CALIBRATOR

### GENERAL

The XCU-303 Deluxe Crystal Calibrator Unit is designed expressly for use with your NC-303 receiver. In addition to providing crystal controlled marker frequencies every 100 kilocycles over the entire tuning range of your NC-303, the Deluxe Calibrator provides for direct calibration of the 100th harmonic of the 100-kilcycle frequency against WWV (10 mc). The calibrator consists of an electron-coupled 100-kilcycle crystal oscillator, and a 10-megacycle mixer. The mixer converts the beat between WWV and the 100th harmonic of the oscillator to 7.07 megacycles. This frequency is marked in red on the 40-meter dial scale of your NC-303.

### INSTALLATION

The XCU-303 Deluxe Crystal Calibrator is installed in the NC-303 receiver by plugging the unit into the Crystal Calibrator Socket, X-1, on top of the chassis. A short antenna (10 to 30 feet long, depending upon geographical location) should be connected to the ANTENNA binding post on top of the XCU-303 Calibrator.

### OPERATION

The XCU-303 Deluxe Crystal Calibrator provides a means of checking the accuracy of the frequency calibration of your NC-303 against a secondary frequency standard whose accuracy is controlled by WWV. The front-panel mounted calibrate switch marked OFF-CAL-WWV connects B-plus to the 100-kilcycle oscillator in the CAL position for instantaneous service. In the WWV position B-plus is applied both to the 100-kilcycle oscillator and to the 10-megacycle mixer. The 100th harmonic of the 100-kilcycle oscillator is beat against the incoming 10-megacycle WWV signal and is mixed down to 7.07 megacycles by the local oscillator-mixer combination where it is picked up on your NC-303 receiver.

To check the accuracy of the 100-kilcycle crystal oscillator, turn the OFF-CAL-WWV switch to WWV, the MODE switch to AM and the BAND switch to the

7-megacycle (40 M) band. Tune your NC-303 to the red mark on the dial scale. The beat between the 100-kilcycle oscillator and WWV should be heard. Adjust the trimmer capacitor at the top of the XCU-303 Deluxe Calibrator for zero beat between the 100-kilcycle oscillator and WWV. The 100-kilcycle oscillator is now at exactly 100 kilocycles. This adjustment may be checked as frequently as desired.

To check the calibration accuracy of your NC-303 on any band except 6, 2 or 1 1/4 meters, tune in the desired marker frequency with the MODE switch set at CW and the CWO knob marker at 12 o'clock, and zero beat the receiver with the desired marker. If the slide-rule dial does not read accurately, correction should be made by adjusting the front-panel mounted CAL-SET control. Only a slight adjustment of the CAL-SET control should be necessary. If calibration is far off, the RF coils associated with the band being checked probably require realignment and reference should be made to Section 4.

### NOTE

The XCU-303 should not be used on 6, 2 or 1 1/4 meters because the calibrator does not supply an output through the converters.

### ALIGNMENT OF THE XCU-303 MIXER

If the beat between the 100-kilcycle harmonic and WWV does not appear exactly at the 7.07 megacycle red mark on the NC-303 dial, the slug adjustment of the OSC coil probably is not correct. Find the WWV 100-kilcycle beat signal near the 7.07 marker on your NC-303 dial. With an alignment tool, turn the slug of the OSC coil slightly clockwise if beat note is below 7.07 megacycles, slightly counter-clockwise if beat note is above 7.07 megacycles. Note the new position of beat note on your NC-303 dial. Repeat the above procedure until beat note peaks on 7.07 megacycles on your NC-303 dial. The slug of the DET coil may then be peaked for maximum S-meter reading on the 10-megacycle WWV signal. This is most easily accomplished with the 6AK6 100-kilcycle oscillator tube out of its socket.

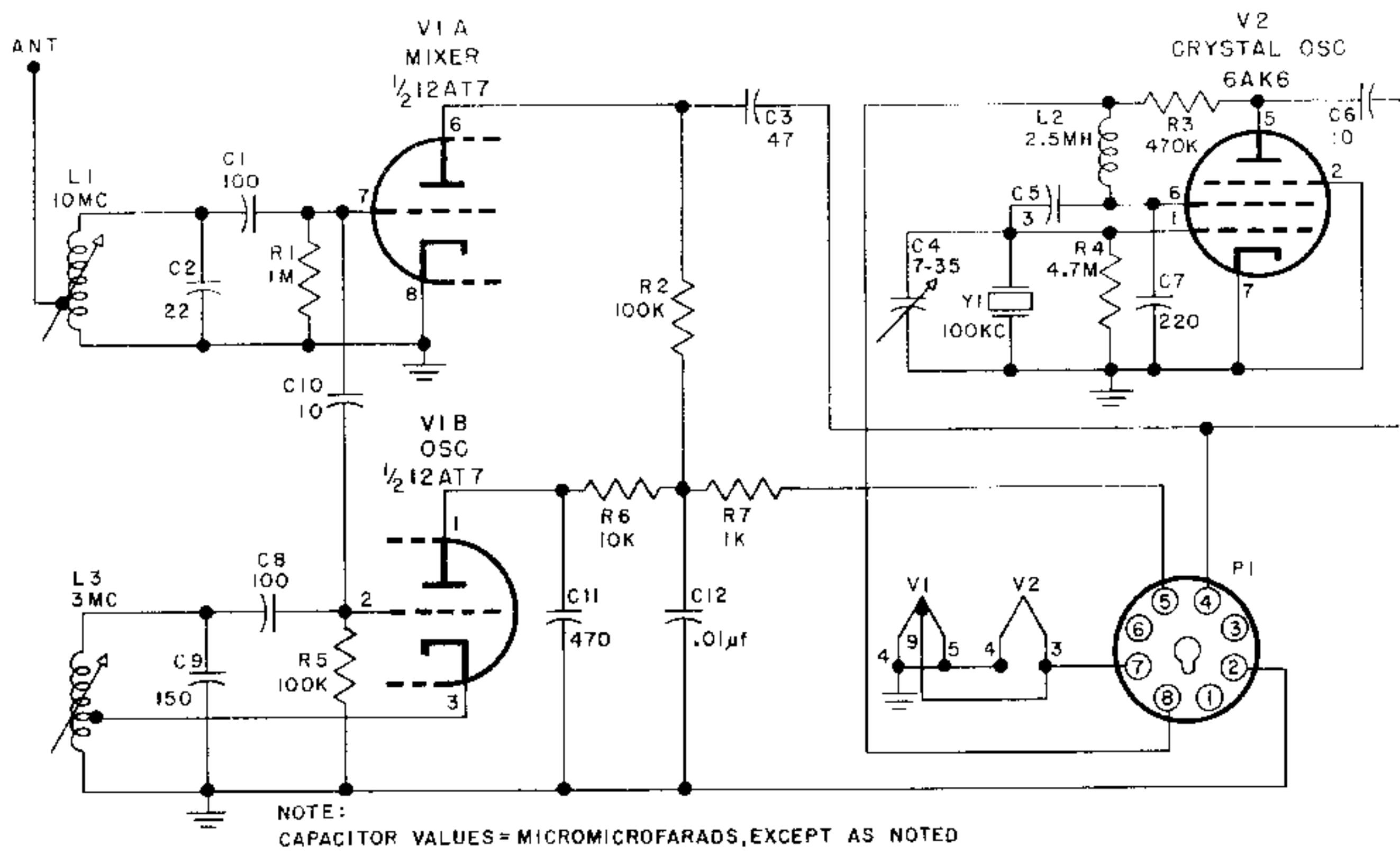


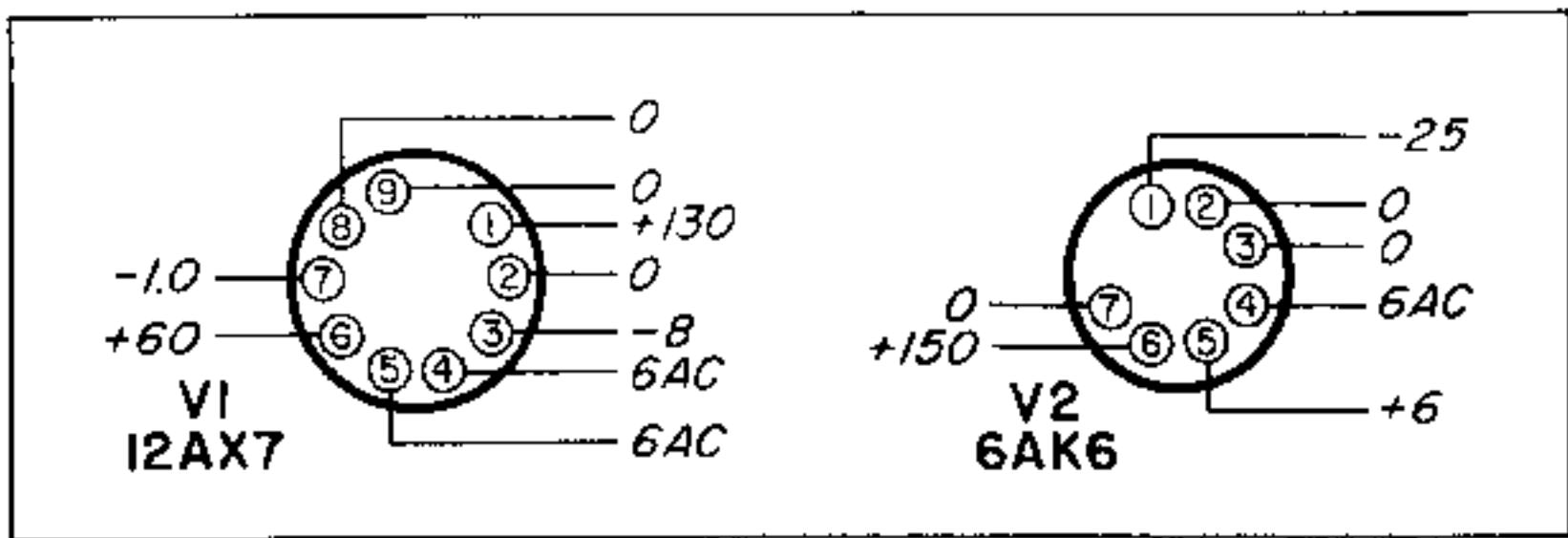
Figure 6. XCU-303 Schematic Diagram

**XCU-303 PARTS LIST**

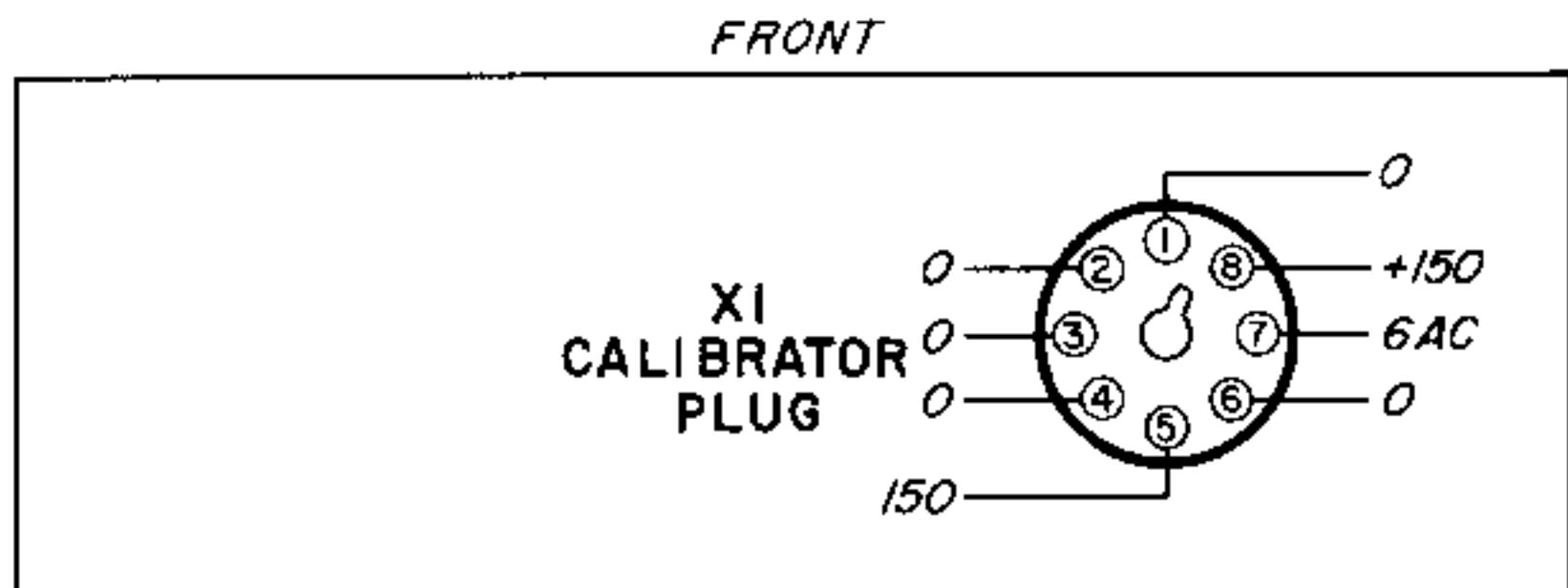
SYM-BOL	DESCRIPTION	NATCO TYPE
C1	Disc, 100 mmf, 500 vdcw	2C11Z5P-101-K
C2	Ceramic, 22 mmf	CCC2OUJ220K
C3	Ceramic, 47 mmf	CCC2OUJ470K
C4	Variable, 7-35 mmf	E311-4
C5	Mica, 3 mmf, 500 vdcw	NCS-15-030-X-5
C6	Ceramic, 10 mmf	CCC2OUJ100F
C7	Mica, 220 mmf, 500 vdcw	NCS-20-221-J-5
C8	Disc, 100 mmf, 500 vdcw	2C11Z5P-101-K
C9	Ceramic, 150 mmf	CCC32PH151K
C10	Mica, 10 mmf, 500 vdcw	NCS-15-100-X-5
C11	Disc, 470 mmf, 500 vdcw	2C14Z5V-103-GMV
C12	Disc, .01 mmf	2C14Z5V-103-GMV
L1	Coil, 10 mc	B23895
L2	Choke, 2.5 mh	SA-3080

SYM-BOL	DESCRIPTION	NATCO TYPE
L3	Coil, 3 mc	B23896
P1	Octal	K783-1
R1	Fixed, 1 megohm, 1/2 w	RC20BF105K
R2	Fixed, 100 K ohms, 1/2 w	RC20BF104K
R3	Fixed, .47 megohms, 1 w	RC30BF474K
R4	Fixed, 4.7 megohms, 1/2 w	RC20BF475K
R5	Fixed, 100 K ohms, 1/2 w	RC20BF104K
R6	Fixed, 10 K ohms, 1/2 w	RC20BF103K
R7	Fixed, 1 K ohm, 1/2 w	RC20BF102K
V1	12AT7	12AT7
V2	6AK6	6AK6
Y1	Quartz crystal, 100 kc	A16126

BOTTOM VIEW OF SOCKETS



FRONT



TOP VIEW OF PLUG

CONDITIONS:

AC LINE VOLTAGE - 115 VOLTS  
HIGH IMPEDANCE VACUUM TUBE  
VOLTMETER USED.  
CONTROL SETTINGS:  
1.OFF-CAL-WWV  
SWITCH IN WWV POSITION  
ALL VOLTAGES MEASURED  
FROM SOCKET PINS TO  
CHASSIS.  
ALL VOLTAGES  $\pm 10\%$ .  
ALL VOLTAGES DC EXCEPT AS  
NOTED.

Figure 7. XCU-303 Calibrator Socket Voltages

**INSTRUCTIONS  
FOR THE  
NATIONAL XCU-300  
CRYSTAL CALIBRATOR UNIT**

## GENERAL

The type XCU-300 Crystal Calibrator may be used successfully with your NC-303. No provision to calibrate the 100-kilocycle oscillator against WWV is provided, however, the XCU-300 Calibrators are set to zero beat with WWV at the factory and will accurately maintain marker frequencies for your NC-303. The XCU-300 calibrator will continue to operate normally when the OFF-CAL-WWV switch is moved from the CAL to the WWV position, but no WWV signal will be obtained.

## INSTALLATION

The XCU-300 Crystal Calibrator is installed in your NC-303 receiver by plugging the unit into the Crystal Calibrator Socket, X1, on top of the chassis.

## OPERATION

The XCU-300 Crystal Calibrator provides a means of checking the accuracy of the frequency calibration of the receiver. The front-panel mounted OFF-CAL-WWV switch connects B-plus to the calibrator for instantaneous service. To check calibration accuracy tune in the desired marker signal with the MODE switch set at CW and the CWO knob set at 12 o'clock. Zero beat the receiver with the harmonic marker. If the slide-rule dial does not read accurately correction should be made by adjusting the front-panel mounted CAL-SET control. Only a slight adjustment of the CAL-SET control should be necessary. If calibration is far off, the RF coils associated with the band being checked probably require realignment and reference should be made to Section 4.

## XCU-300 PARTS LIST

SYMBOL	DESCRIPTION	NATCO TYPE
C1	Ceramic, variable 6-20 mmf	E311-2
C2	Ceramic, 10 mmf, 500 vdcw	H872-1
C3	Ceramic, 3 mmf, 500 vdcw	J695-4
C4	Ceramic, 220 mmf, 500 vdcw	K946-24
L1	5 mh, type R-100	SA-2608
P1	Octal	K783-1
R1	Fixed, 4.7 megohms, 1/2 w	J569-69
R2	Fixed, 470,000 ohms, 1 w	J571-57
V1	6AK6	
Y1	Quartz crystal, 100 kc	A16126

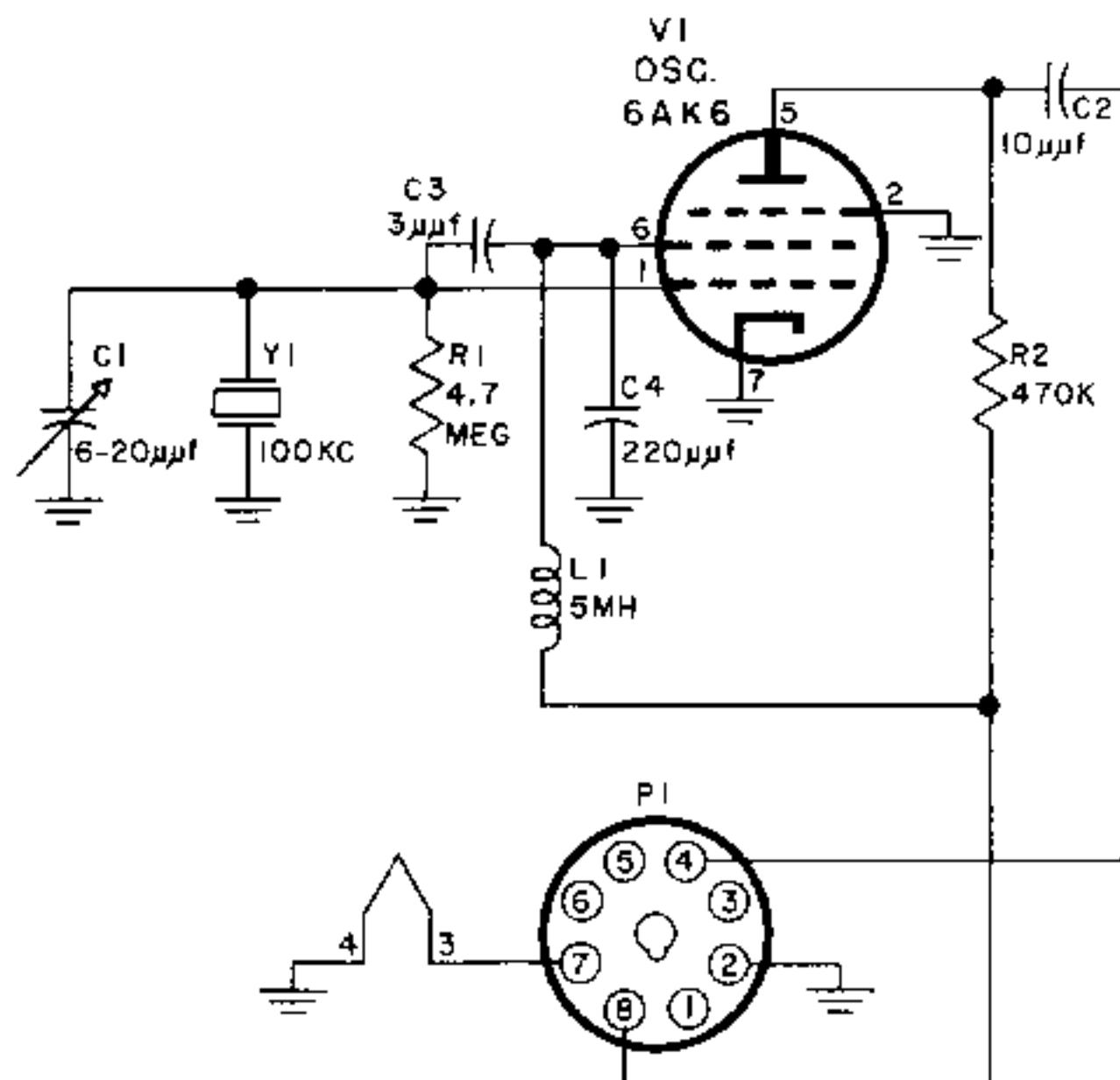
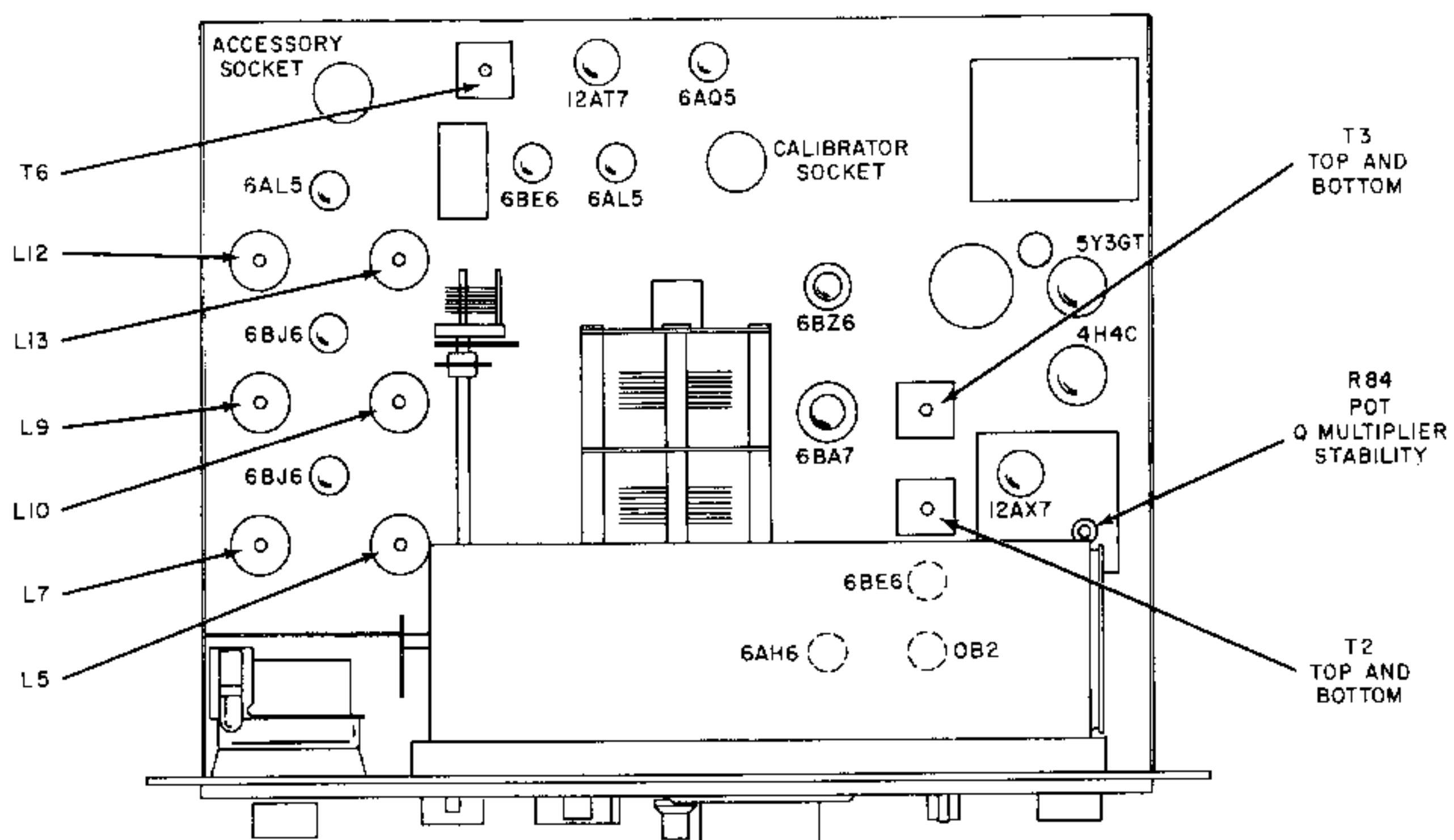
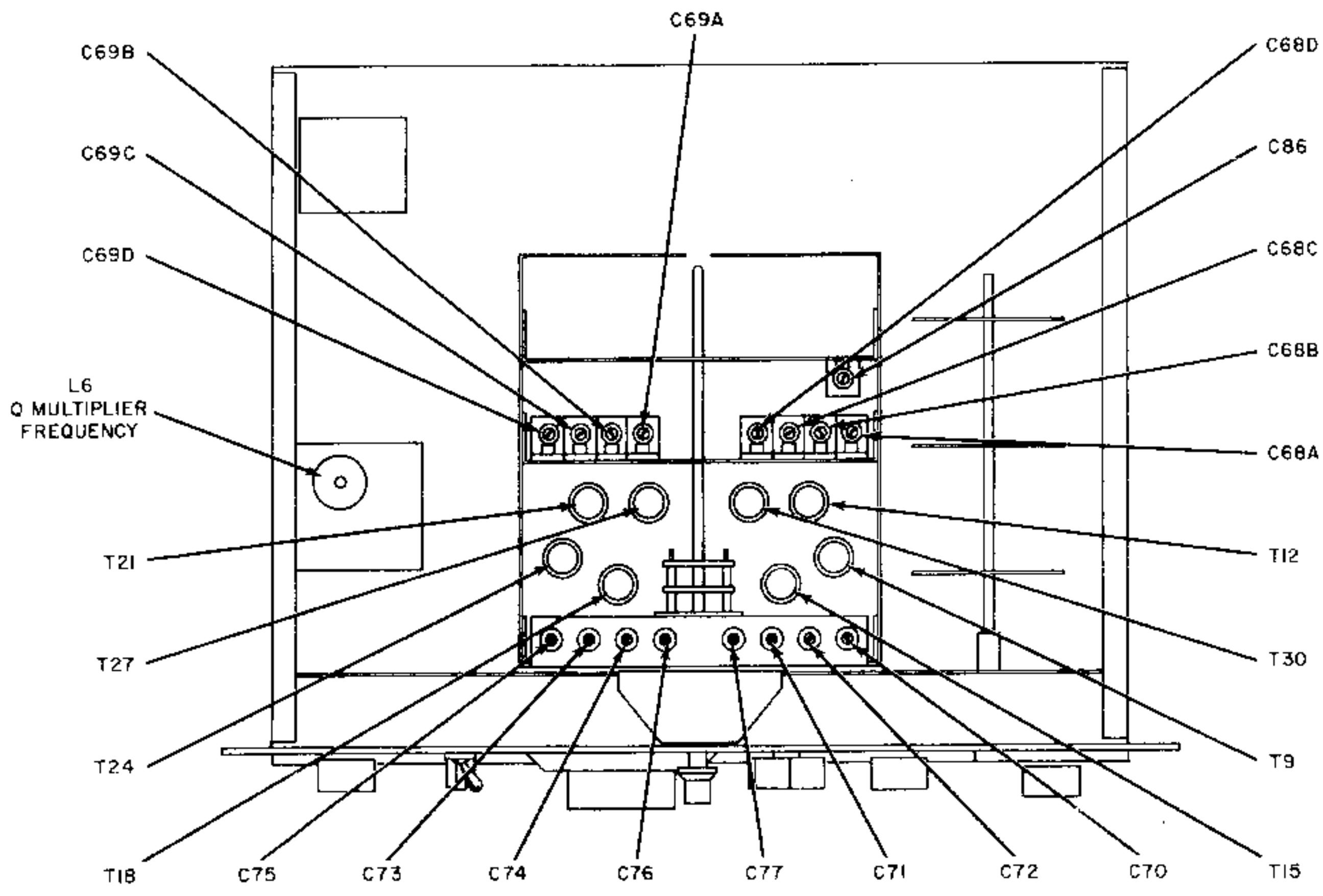


Figure 8. XCU-300 Schematic Diagram



TOP VIEW



BOTTOM VIEW

NC 303 ALIGNMENT CHART

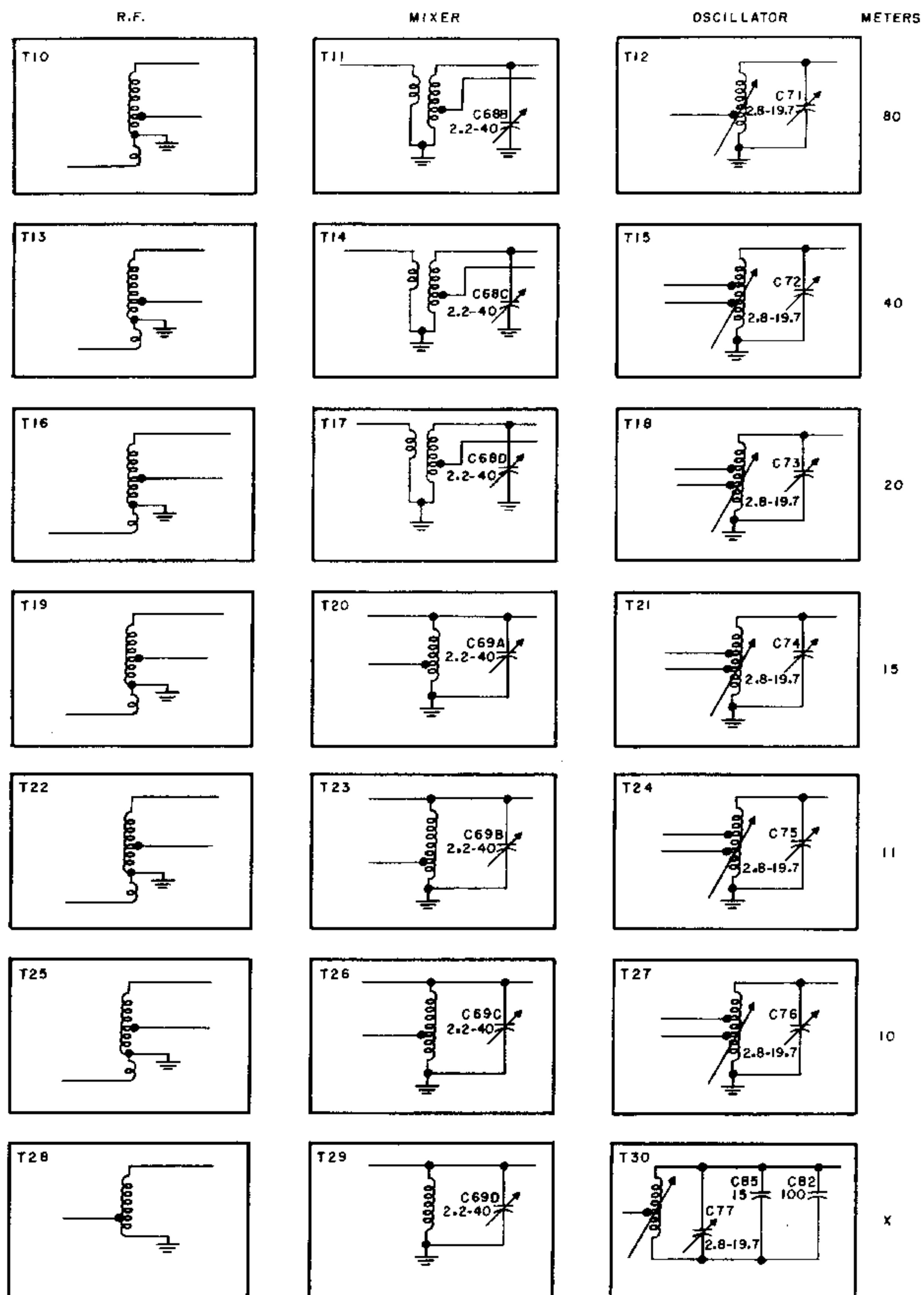
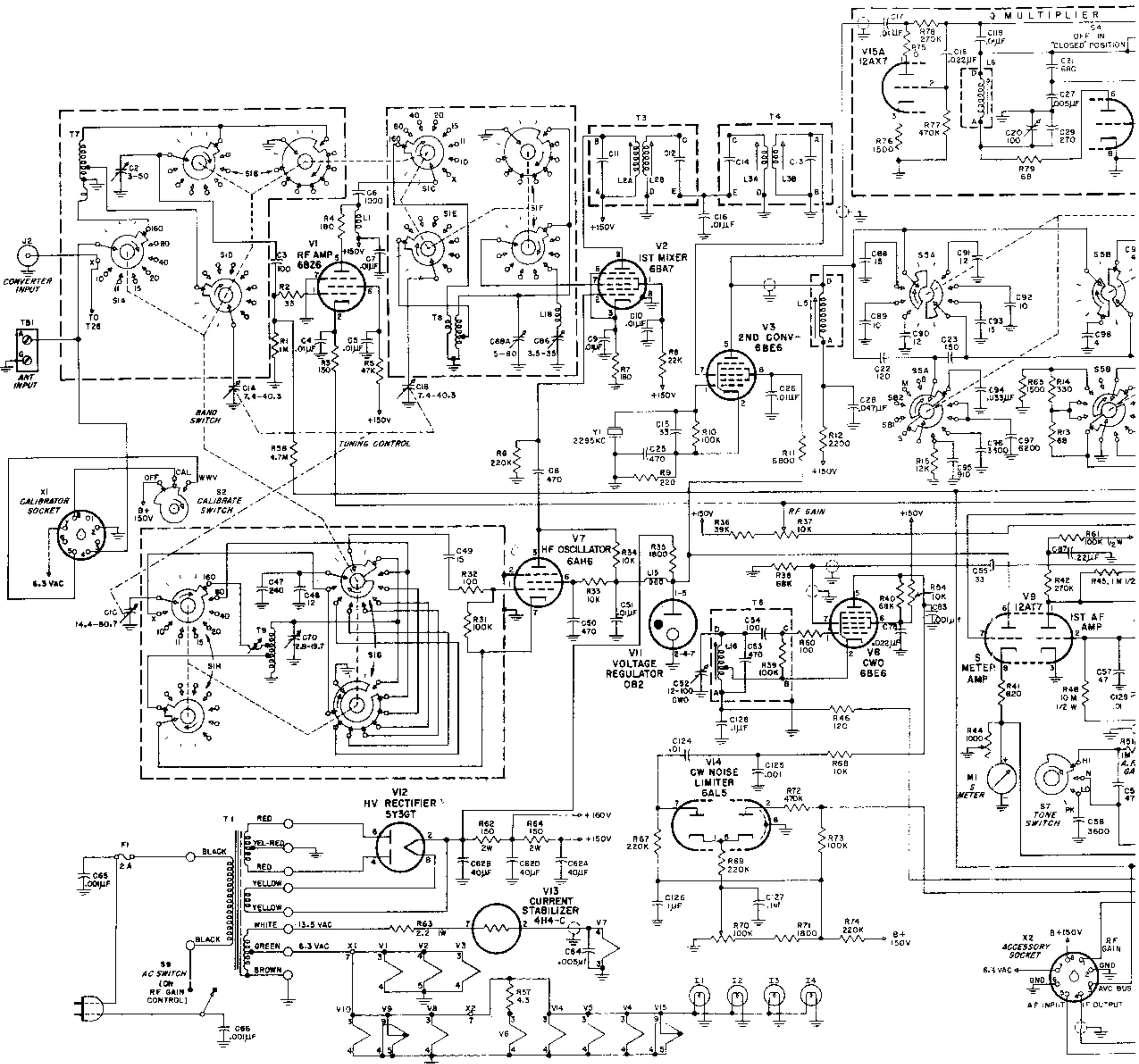
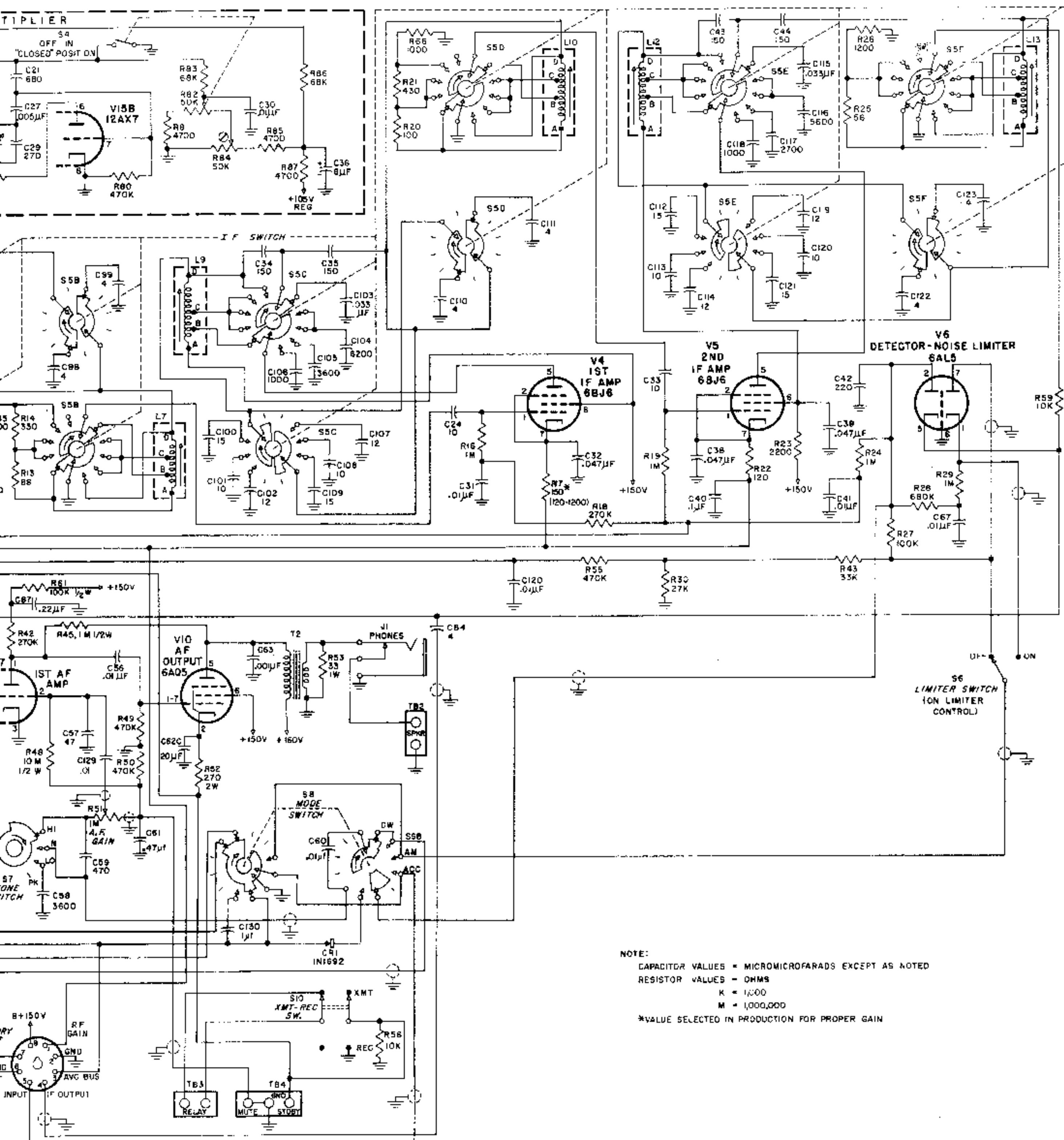


Figure 9. Transformer Schematics





NOTE:  
CAPACITOR VALUES = MICROMICROFARADS EXCEPT AS NOTED  
RESISTOR VALUES = OHMS  
K = 1,000  
M = 1,000,000  
\*VALUE SELECTED IN PRODUCTION FOR PROPER GAIN